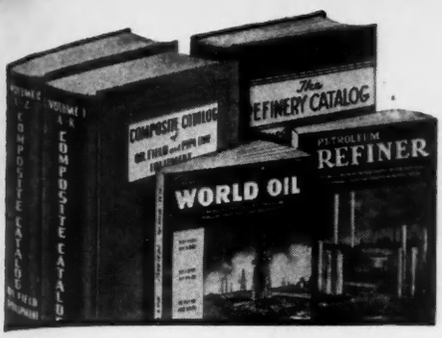


Specialized Oil Publications of
THE GULF PUBLISHING COMPANY
3301 Buffalo Drive, Houston 6, Texas
Box 2608, Houston 1, Texas

WORLD OIL and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

PETROLEUM REFINER and The REFINERY CATALOG
for the refining-natural gasoline industry

RAY L. DUDLEY, *President, Publisher*
A. L. BURNS, *General Manager*

EDITORIAL STAFF

WARREN L. BAKER, *Editor*
AL REESE, *Managing Editor*
L. J. LOGAN, *Associate Editor*
ELTON STERRETT, *Engineering Editor*
GEORGE O. IVES, *Internationanal Editor*
CECIL W. SMITH, *Statistical Editor*

DISTRICT EDITORS

J. E. KASTROP, 3301 Buffalo Drive, Houston 6, Texas
HENRY OZANNE, 250 Park Ave., New York 17, N. Y.
GILBERT M. WILSON, W. W. Wilson Bldg., Huntington Park, Calif.
ANTHONY GIBBON, Hunt Bldg., Tulsa 3, Okla.

MARION DENNARD BETTY HENDERSON
Editorial Assistants

MARY E. POOLE, *Librarian*

ADVERTISING STAFF

TOM W. NELSON, *Advertising Manager*
RANDALL BROOKS, *Assistant Advertising Manager*
ROGER MOTHERAL, *Eastern Advertising Manager*
250 Park Ave., New York 17, N. Y.
NELSON BIGELOW, 250 Park Ave., New York 17, N. Y.
FRANK VICKREY, 250 Park Ave., New York 17, N. Y.
BILL WESTFALL, 1010 Euclid Ave., Cleveland 15, Ohio
H. G. FITZPATRICK, 332 S. Michigan Ave., Chicago 4, Ill.
BILL ATCHESON, Hunt Bldg., Tulsa 3, Okla.
J. W. CURTS, W. W. Wilson Bldg., Huntington Park, Calif.
CHARLES WYATT, 3301 Buffalo Drive, Houston 6, Texas

CIRCULATION DEPARTMENT

CLINTON S. QUIN, JR., *Manager*

Published every month except semi-monthly in February and July. Single copies 50 cents (except special issues). Subscription price: domestic and foreign, $2 a year; 2 years, $3; 3 years, $4. Advertising rates on application.
Copyright, 1949, by The Gulf Publishing Company.

Indexed by Industrial Arts Index and Engineering Index

Be Sure

to have your personal subscription to WORLD OIL in time for the special Canadian issue in December. The most complete story on Canadian operations ever published.
See page 298, this issue.

ABC

WORLD OIL

ABP

Established 1916 as THE OIL WEEKLY

CONTENTS

October, 1949 **Vol. 122, No. 7**

CURRENT OUTLOOK SECTION

Publisher's Page: Know-How Gets the Job Done — *Ray L. Dudley* — 21
Report from the Observatory: Industry's Economic Position Now in Best Balance of Year — *Ray L. Dudley and Warren L. Baker* — 23
The Changing Panorama — 25
Monthly News Analysis — 27
Petroleum Trends: August Crude Production Is Raised 30,000 Barrels Daily — *Cecil W. Smith* — 32
Completions Lead 1948 Period in Footage — 34
Looking Ahead — 35
Control of Materials Through the Use of Lease and System Maps — *R. K. Pearson* — 38
A Nickel for a Friend: Shell's Motion Picture Program — *Al Reese* — 44
Unitization Desirable in Secondary Recovery — *W. A. Heath* — 48
The Foreman's Responsibility in Employe Indoctrination — *Richard Peters* — 56

EXPLORATION SECTION

Interpretative Petrology of Sedimentary Rocks — *Dr. Gordon Rittenhouse* — 61
Geology of the Strake and Squire Field Area, Duval County, Texas — *George G. Huffman and Alfred E. Giles* — 68
Exploration 12 Percent Above 1948 Period — *Cecil W. Smith* — 78

DRILLING SECTION

Engineering Simplifies Steam Rig Hookup — *Elton Sterrett* — 87
World's Biggest Rig Drills World's Deepest Well — *Gilbert M. Wilson* — 92
Use of Improved Drilling Fluids in Well Completion — *J. E. Sherborne and P. W. Fischer* — 112
Radioactive and Electrical Logging — *V. J. Mercier* — 128
How to Do It—Drilling Hints — 134

PRODUCTION SECTION

Notes on Galvanic Corrosion — *F. L. LaQue and W. D. Mogerman* — 153
Pressure Drop for Oil-Gas Mixtures in Horizontal Flow Lines — *N. van Wingen* — 156
Application and Efficiency of Gas-Lift — *Charles C. Bankhead, Jr.* — 160
California Water-Flooding Practice and Research — *W. H. Somerton* — 164
Field and Laboratory Tests of Sodium Chromates and Alkalies for Controlling Corrosion in Gas Condensate Wells (Fourth of Six Parts) — *C. K. Eilerts, R. V. Smith, F. G. Archer, L. M. Burman, Faye Greene, and H. C. Hamontre* — 174
Reservoir Reconditioning Conserves Water-Drive Energy — *F. R. Cozzens* — 183
How to Do It—Production Hints — 185

PIPE LINE SECTION

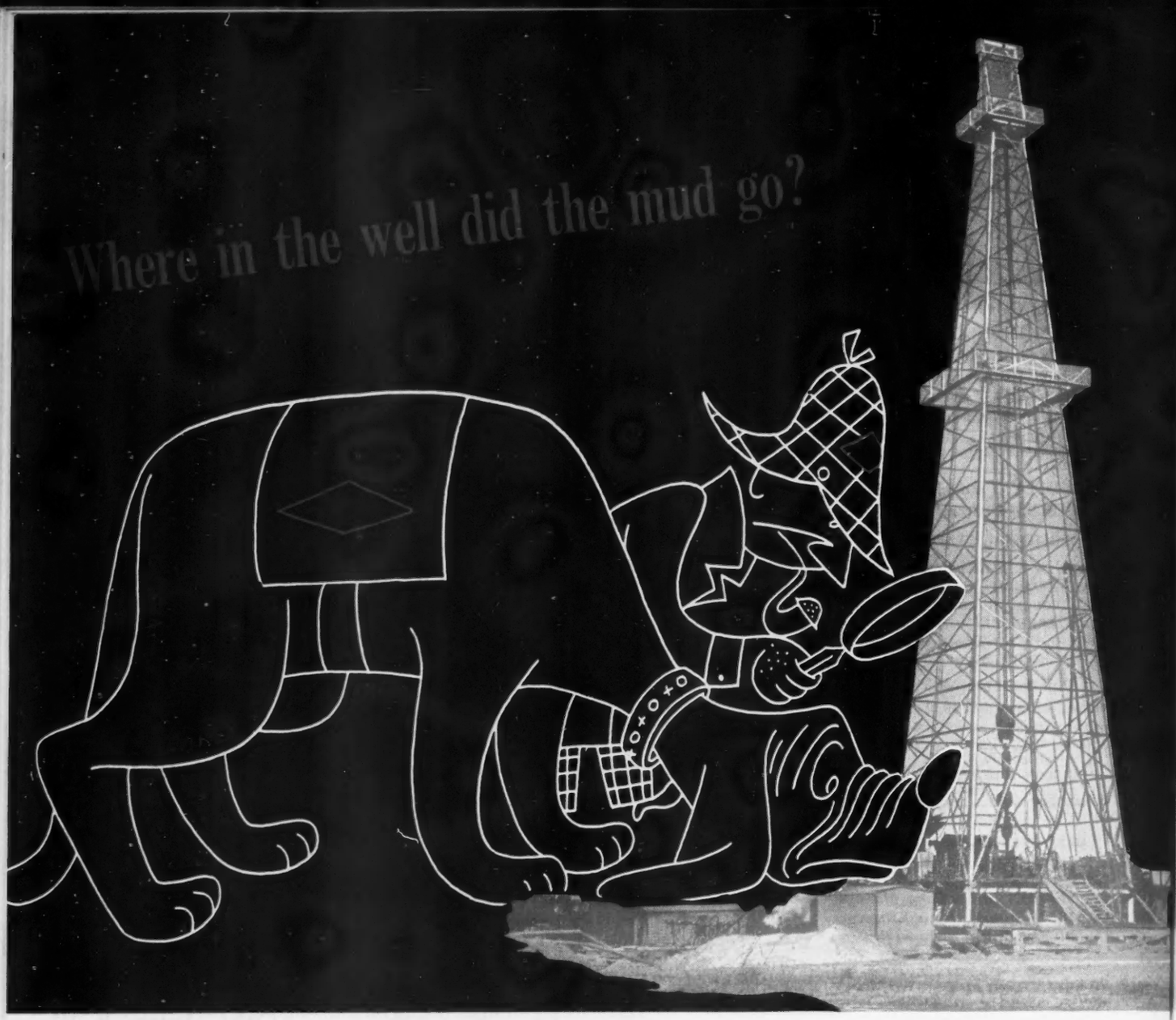
Portable Pipe Line Boosters — *Fred B. Crandall* — 195
One-Man Pipe Alignment Device — *Gilbert M. Wilson* — 198
Radar in Pipe Line Surveying — 199
Energizable Lubricant — 201
Pipe Line Construction — 204
How to Do It—Pipe Line Hints — 208

INTERNATIONAL SECTION

Cuban Activity Resumed — *Sigurd Scholle* — 221
Oil Abroad — *E. E. Barberii* — 226
Outlook for Middle East Operations Improves — 232
Japan May Import Sterling Crude on U. S. Ships — *Henry Ozanne* — 233
U. S. Independents to Begin Operations in Mexico — *George O. Ives* — 234
The Brazilian Oil Picture — 235
Exploration in Germany Meets with Increasing Success — 238
Market Demand Increasing for Alberta's Light Oils — 242
Oil Men Investigate Rigs Available in Western Canada — 244
High Operating Costs Prevent U. S. Tanker Fleet Expansion — 244

OTHER DEPARTMENTS

The Oil Man's Calendar — 16
New and Improved Equipment Supplementing Composite Catalog — 246
Other New and Improved Equipment — 254
New Literature — 260
Associations — 263
Men in the Industry News — 270
Equipment and Service Suppliers' Notes — 284
Classified Advertising (Trading Post) — 300
New Books, Maps and Movies — 301
Squeaks from the Bull Wheel — 302
Advertisers' Index — 302



DOWELL SPINNER SURVEY located thief formation accurately when lost circulation threatened drilling

When remedial work is necessary to restore lost circulation, a key question is the exact location of the one or more thief zones. An accurate source of this information is a Dowell Spinner Survey, one of the Electric Pilot services.

Spinner Surveys made by Dowell engineers have made it possible to pinpoint the zones where the loss is occurring. With this information the remedial work can be accomplished more quickly and economically, and with the best possible chance of success. For example: After drilling to 8900 feet, loss of returns occurred when the mud weight was increased. No satisfactory material could be found to restore circulation, so a Dowell Spinner Survey was made. This showed the mud loss was occurring between 2195 and 2300 feet. This zone was squeezed off and drilling continued with full circulation.

Location of thief zones is only one of the proved uses of the Spinner Survey. Ask your Dowell engineer about using a Spinner Survey to determine the relative permeability of exposed zones in a producing or injection well, the relative production of zones in a producing oil or gas well, the location of holes in pipe and leaks in casing seats and bottom hole plugs.

DOWELL INCORPORATED
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

DOWELL
SPINNER SURVEY

Ask your nearest Dowell station for complete information on these Dowell services and products: Acidizing, Electric Pilot Services, Plastic Service, Chemical Scale Removal Service for heat exchange equipment, Jelflake, Paraffin Solvents, Magnesium Anodes for corrosion control, and Bulk Inhibited Hydrochloric Acid.

"Petroleum Promotes Progress"

Look to DOWELL

FOR OIL INDUSTRY CHEMICAL SERVIC

KNOW-HOW GETS THE JOB DONE

AMONG AMERICAN EXPRESSIONS which have grown popular during the past few years because it is so fitting, is "know-how," meaning to have a practical working knowledge of the proposition under consideration.

Know-how involves not only a knowledge of the theory or theories involved, but includes also the supposition of having actually worked in a practical manner to carry out the theory.

Without know-how even the most aggressive enthusiast may get balled up in a maze of conflicting theories. Know-how is the brake so necessary to keep personal ideas from running away, with a consequent smashup.

Know-how represents the difference between success and failure on most jobs.

No amount of front, no amount of pull, no amount of good intentions can be substituted for know-how.

We wish we had more know-how in high governmental circles—circles within our own government and others as well.

• • •

IF ANYONE, be he business man or labor leader, soberly studied the things which make for success, either as a labor leader or as a business man, we believe that "obligation to the job" would unfailingly be included as one of the most important musts.

Yet this sense of obligation to the job is something which seemingly is falling more and more into disrepute every day.

We were shocked when we read sometime ago the pronouncement of a leader in the CIO's automobile union regarding the anniversary plans of Packard Motor Company. The pronouncement indicated an actual desire on the part of some to destroy the sense of obligation which workers had to the job providing them and their families with a livelihood, and along with it, destroy or at least damage the company providing such jobs.

No one can deny that among the first obligations laid upon a worker is the care of his family. But seldom, if ever, does that obligation involve the destruction of the job or the company employing him. Common sense tells us that as jobs are destroyed, workers are thrown out of employment. Common sense also would incline us to suspect, therefore, the motives of a labor leader willing to see the jobs of his members destroyed.

Many labor leaders recognize that the success of the employer is tied up in a concrete manner with the success of the employe.

Dave Beck, president of the Teamster's Union, expressed it this way in a recent speech, a copy of which his organization sent me:

"I point out to you what we learned long ago; no one can take good wages, hours and working conditions from a bankrupt concern."

Now we have found ourselves in violent disagreement with Dave Beck and his organization on many occasions, but he was speaking horse sense in the sentence above.

Here is what a profound sense of obligation will do to a man:

It will make him a more worthwhile employe and fit him for promotion. (He is extremely unlikely to get promotion or to hold it unless he does have a sense of obligation to his job.)

It aids the company to provide a better job for him.

Both of the foregoing add up to a happier existence on the part of all.

• • •

WE HAVE JUST re-read a book which every oil man ought to have. We say "re-read" because we read the book first in its manuscript form, and then had the further pleasure and instruction of reading it in published form.

The name of the book is "OIL, Titan of the Southwest" and it is a most interestingly done history of the development of oil in all of the Southwestern states. Its author is Carl Coke Rister, Research Professor of the University of Oklahoma. The book was prepared under a grant from the Standard Oil Company (N. J.) which, without strings provided funds which made the research possible.

Rister has traced the beginnings of development in every Southwestern oil area. He has made no attempt at the dramatic, but the drama of the world's most interesting industry creeps into the thread of the story all the way along.

It is the kind of story which could not have been as well written at any other date. Enough perspective has been furnished by time to sift out the rumor from the fact, and enough of the old timers (though far too few) are still alive to provide first-hand information. Ten more years would have been too late for the interviews Rister had with some of the men who were in the thick of things in the beginning of Southwest oil.

Each area has been given a chapter, which makes it easy to read without losing the thread of the history. So far as we know it is the only history of oil in the Southwest since the beginning.

Ray L. Dudley

REPORT FROM THE OBSERVATORY

Industry's Economic Position

By **RAY L. DUDLEY**, Publisher, and **WARREN L. BAKER**, Editor

CONTINUED MARKED IMPROVEMENT for the third consecutive month brought the industry's economic position at the end of September into its best balance of the year. Outside of California, where a critical over-supply exists, further enlargement of producing and refining rates appear certain if predicted gains in heating oil demand prove anywhere near right. Barring increased importation of foreign oils and failure of refiners to make proper adjustments in refined product yields, prospective higher producing and refining operations should not disturb the industry's present very favorable position.

In addition to an anticipated sharp rise in consuming rates, the industry's extremely encouraging outlook is based upon these developments: accelerated drafts on crude stocks despite enlarged producing rates have decreased these inventories to a point where it becomes desirable to discontinue withdrawals; slower accumulation of distillate fuel have brought stocks of this commodity so much closer to 1948 volumes that increased output appears necessary; and outside of California residual fuel oil stocks have declined substantially and now are well below levels of a year ago.

The marvelous improvement in the petroleum economic position shows what can be done when the industry properly regulates its operations.

• • •

HEAVY DRAFTS ON CRUDE stocks have placed crude oil in an especially strong position, in direct contrast with the outlook three months ago. Although crude production for the nation in September averaged around 4,850,000 barrels daily, a gain of 125,000 barrels per day over August, stocks of crude oil declined at an increased pace. On September 17 they totaled only 260½ million barrels, a decrease of 6 million barrels (213,000 barrels daily) in the four weeks since August 20. Since the end of May, when crude storage hit a high for the year of 275 million barrels, these stocks have dropped 15 million barrels or 131,000 barrels per day.

At present levels, crude inventories are at, or near, the minimum volume required for adequate working stocks. Nevertheless, further reductions in crude oil inventories are indicated for October, production increases scheduled for the month not being sufficient to balance supply with demand in face of recent withdrawal rates and anticipated consumption growth.

Consequently, large production gains are indicated for the last two months of the year. With increased demand anticipated during this period, increases in producing rates during November and December may be larger than those in September and October. For example, it would appear that Texas will be permitted to produce an additional day during November, although the state increased its producing days by one during both September and October. If conditions follow the pattern indicated now, still another producing day may be permissible during December.

Prospects for enlarged producing rates were further enhanced when importing companies last month told the Texas Railroad Commission they would import an average of 430,000 barrels of crude oil daily during the last four months of the year. The commission had asked each individual company to report how much foreign crude it would bring into the U. S. during September, October, November and December. However, many still fear imports may jump sharply in the latter part of the year, as they did in 1948. Any large increase in imports would retard domestic production gains.

• • •

RECENT SHORTAGES of crude have eliminated all danger of further crude price reductions, except in California where an oversupply makes price cuts appear probable. Nevertheless, it is not likely that any increases in prices will occur, since refined product prices are considered low as compared with crude prices.

• • •

REFINED PRODUCTS also experienced favorable trends during September, particularly with respect to distillate and heavy fuel oils.

Distillate fuel oil stocks no longer are considered excessive, and may prove to be on the low side. These stocks amounted to 80 million barrels on September 17, a very small seasonal increase of but 5 million barrels since August 20. This rate of accumulation was only half of the 10 million added to these stocks during the corresponding period of 1948. Consequently, distillate fuel oil inventories currently are only 11 million barrels greater than a year ago, whereas they were 16 million above a year ago on August 20 and 19 million barrels larger on July 23. A considerable portion of the growth in distillate fuel stocks has occurred in California. Outside of the West Coast, stocks of distillate fuel amounted to slightly less than 66 million barrels, and were only 6⅓ million barrels above year ago levels. Anticipated sharp growth in heating oil consumption, generally expected to be 20 percent or more greater than last winter, will more than offset this gain. If consumption approaches predicted levels, refinery output of heating oils must be increased rather sharply in coming months to provide an adequate supply.

Residual fuel oil stocks have not increased since August 20, amounting to 68½ million barrels for the nation as a whole on September 17. However, the

Now in Best Balance of Year

WORLD OIL'S summary of the oil situation at the close of September

residual fuel picture is much better than indicated by nation-wide inventories, since half of these stocks are located in California. Outside of California, residual fuel stocks on September 17 were 28½ million barrels, after declining steadily since the end of June and currently are 8½ million barrels under year ago levels.

Prospects for both distillate and heavy fuel oil consumption to rise sharply in the immediate future continued to improve. The coal strike may have beneficial effects, and in contrast with a year ago there is no maritime strike to retard bunker fuel demand.

Inventories of gasoline are not in as favorable a position as those for fuel oils. The industry would be better off if it had 7 to 10 million barrels less gasoline in storage. Although continuing to decline, stocks of gasoline were 103⅓ million barrels on September 17, which was 11½ million barrels above year ago levels. With the end of the heavy gasoline consuming season at hand, these stocks will begin their normal seasonal increase in the near future. Unless refiners adjust gasoline yields downward, they could become quite excessive before next April. This would have a most damaging influence on the industry's whole economic position. However, if refiners reduce gasoline yields, motor fuel inventories can be kept from becoming excessive.

• • •

REFINERY YIELDS need to be adjusted immediately to yield more fuel oil and less gasoline. If this is accomplished the industry is in an excellent economic position for next year.

Highly encouraging in this connection was some progress in this direction during the past month. Whereas 50 percent of all the crude run to stills in August and July was converted into gasoline, refiners during the first three weeks of September trimmed this to 49 percent and at the same time increased heating oil yields from 16½ percent to 18 percent.

Price is the controlling factor in the adjustments of refinery yields, as pointed out last month in these columns. As long as fuel oils remain less profitable than gasoline, there will be a reluctance on the part of refiners to increase the yield of distillate oils. Recent advancements in fuel oil prices undoubtedly will prove stimulating, but may not yet be sufficient to provide enough incentive for refiners to make the desired adjustments in yields. Additional fuel oil price gains may occur in view of the improved situation, and because of their probable influence on refinery yields would be the most important development that the industry could experience.

The longer the industry postpones raising distillate yields, the more likely are spot shortages to occur if coming winter heating oil demand approaches expectations. Futhermore, the present high gasoline yield might also contribute to a weakened price structure for this product now that the gasoline consuming season has ended.

• • •

THE CALIFORNIA SITUATION, in direct contrast with conditions in the rest of the nation, was serious and steadily becoming more and more acute. Continuing over-production of crude oil, both heavy and light grades, has created an unbalanced condition between supply and demand with critical implications for the future. The problem is due principally to large surpluses of heavy fuel oils, but excess production is becoming increasingly apparent in the lighter products also.

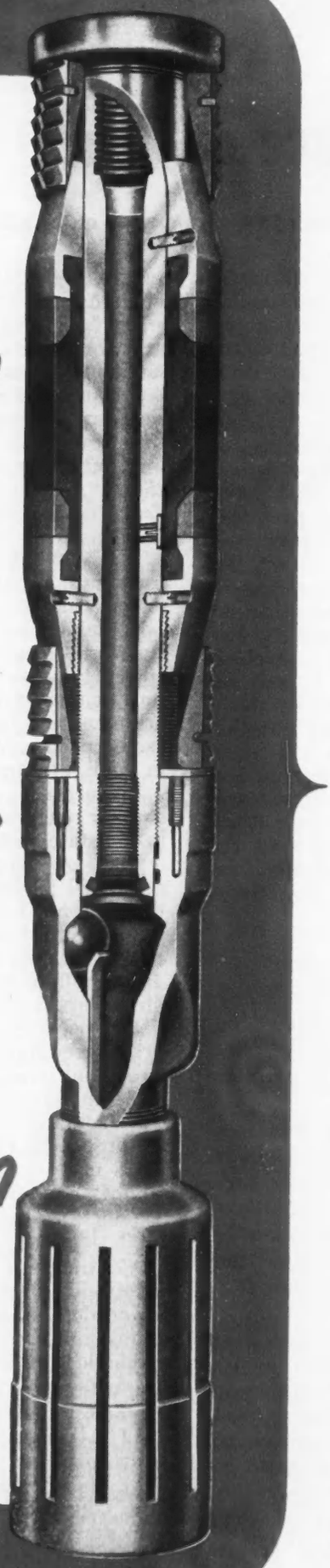
Inventories in the Pacific Coast have increased sharply over year ago levels. Residual fuel oil stocks in the state, in totaling 40 million barrels on September 17, are twice the volume of a year ago and represent 60 percent of all residual fuel inventories in the nation. Distillate fuel stocks amounted to 14¼ million barrels on September 17 in contrast with 9½ million barrels at this time in 1948. Gasoline stocks are 4 million barrels above last year, and crude oil stocks are 5 million barrels higher than a year ago.

Prospects for checking the excessive producing rate are exceedingly dark. Although the second largest producing state in the Union, California has no petroleum conservation law and production cannot be cut back and controlled by law as in other important oil producing states. While production cutbacks have been made in some fields, increases in others have almost counterbalanced the decreases so that total production for the state has not declined in keeping with demand.

Continuation of the present trend of accumulating additional stocks can result only in further reductions in crude and refined product prices. Under existing conditions, pipe line proration appears to offer the possible solution to California's situation.

Fortunately for the industry as a whole, California is far removed from the heavy consuming Mid-West and Atlantic Seaboard regions. Consequently, the critical West Coast condition is not likely to have any material bearing on the industry in the rest of the country. However, one Pacific Coast company has contracted to deliver 2 million barrels of heating oil to the Atlantic Seaboard during autumn and winter months, the first big shipment from the West Coast to the East Coast since 1934.

why are more and more Baker Cement Retainers being made of magnesium ?



That's a fair question and here's the answer:

Magnesium is chosen for making many products because of its light weight as compared to steel, cast iron, or any suitable non-ferrous metals. This is not true of the Baker ***Magnesium*** Alloy Cement Retainer, (Product No. 5-400) where ***magnesium*** is used on account of the greater *ease, speed and safety* with which it can be *completely drilled up.*

All major parts of this retainer are made of ***magnesium*** except the annularly segmented nitricastiron slips, which readily break into small pieces when drilling out.

The special ***magnesium*** alloy employed has *ample strength* for all types of *remedial or secondary* cementing, and is well suited for use as a *temporary* bridge plug to prevent movement of liquid or gas up or down the hole. For a *permanent* bridge plug, use the Baker **Cast Iron** Cement Retainer, as certain well fluids ultimately produce a chemical reaction on the ***magnesium***.

Both the ***Magnesium*** Alloy Type and the Cast Iron Type are run on tubing or drill pipe either as a retainer for cementing or testing, or as a casing bridge plug.

Use as a WIRE LINE Bridge Plug

A successful method recently has been developed for setting the Baker Model "K" Retainer Bridge Plug when run on a wire line. The savings in running time, savings of wear and tear on drill pipe or tubing, and other worthwhile advantages, merit your consideration of the "Baker Wire Line Bridge Plug" as it is popularly referred to in the field. Any Baker representative or office will furnish the names of service organizations ready to assist you.

FOR COMPLETE INFORMATION

. . . on the Baker ***Magnesium*** Alloy Cement Retainer, and its many efficient applications, refer to your BAKER (or Composite) CATALOG, or address:

BAKER OIL TOOLS, INC.

HOUSTON • LOS ANGELES • NEW YORK

The Changing Panorama

More Heavy Fuel to Be Made Into Lighter Oils

SURPLUSES of residual fuel oil and heavy crudes this year have sharply emphasized the desirability of obtaining larger yields of the lighter products and lower yields of residual at the refineries. Consequently, there will be a speeding up of the construction of refinery facilities for reducing yields of residual, a by-product which normally does not afford profit. Refiners throughout the industry will be forced through competition to strive for lower residual yields. In California, however, the problem is especially urgent, and it is getting immediate attention there, with refinery projects already under way for increasing yields of lighter products.

A shift in market demands for petroleum products within the past few years has left Pacific Coast refiners with growing stocks of heavy fuel oil for which there is no apparent market. The region is largely isolated from other markets, producing and using its own oil products, and a significant factor is the substantial amount of heavy crude in California's production and reserves.

The California refiners are well aware of the need for obtaining greater yields of the lighter products and are in the process of providing facilities for that purpose.

Among the recent developments, General Petroleum Corporation has begun construction on a $2,250,000 refinery expansion project to turn more surplus heavy fuel oil into other petroleum products in greater demand. The project will add more than 50 percent to the ability of the company's Torrance, Calif., refinery to squeeze out the last valuable light hydrocarbons contained in the fuel oil, leaving only solid coke. The company began work on the problem in 1946, when it erected a "coker" refining unit in its Torrance refinery capable of processing 15,000 barrels of heavy fuel oil per day, in what is described as a secondary refining process. The current expansion project will increase the capacity of this unit over 50 percent and possibly as much as 80 percent.

Three years of experience in operating the present unit have shown that a barrel of heavy fuel oil fed into the coker unit will yield about 20 percent gasoline and about 50 percent gas oil, some petroleum gases which may be processed into liquefied petroleum gases, and about 85 pounds of coke. A large volume of dry gases (methane and ethane) also are produced.

The coke—over 600 tons daily—is carried away from the refinery in huge trucks. It is used chiefly for the manufacture of electrodes. The existing unit has four huge drums, each 17 feet in diameter and 80 feet high, lined with stainless steel. In them the heavy fuel oil is "cooked" until only solid coke remains. Other components of the unit include a fractionating tower, furnaces, heat exchangers, and de-coking equipment. The expansion project will add two more coke drums and another furnace. The other portions of the existing unit are being revised to permit them to handle the greater charge.

It is expected that two to three years will be required for the California refineries to install sufficient facilities to alleviate their oversupply of heavy fuel.

New Gas Lines Benefit Producer and Consumer

NATURAL GAS producers of the Southwest and consumers all over the country will benefit from the large postwar programs of natural gas pipe line construction. Producers gradually are getting better prices at the well as better markets are opened up.

Domestic and industrial consumers in New York, Philadelphia, and other Eastern cities will pay out less for gas as natural gas from the Southwest begins to reach them through the new pipe lines now being built or projected. In some cases, natural gas will replace manufactured gas in distributing systems. In other instances, the natural gas will be mixed with manufactured gas to enrich the latter. In all these cases the consumer will get gas of higher heat content, therefore require less volume of gas, and being charged by volume, will have lower gas bills. Natural gas from the Southwest is about twice as high in heat content as gas manufactured from coal and oil.

Switching over from manufactured to natural gas will entail some cost to consumers as well as the distribution concerns. Equipment will have to be changed to use less air with natural gas than wtih manufactured gas, as the natural needs only about one half as much oxygen to burn efficiently. Equipment changes will not be required, however, where manufactured gas is moderately enriched with natural gas. Gas distributing companies will be able to buy the natural gas for less than the cost of manufactured gas.

During the next several months a switch to natural gas from manufactured gas will be carried out on Staten Island, New York City. The natural gas, from Texas and Louisiana, will be supplied by Texas Eastern Transmission Corporation to New York and Richmond Gas Company, which has been making its gas from coal and oil. The company distributing gas in Brooklyn has plans to begin enriching its manufactured gas to some extent with natural gas.

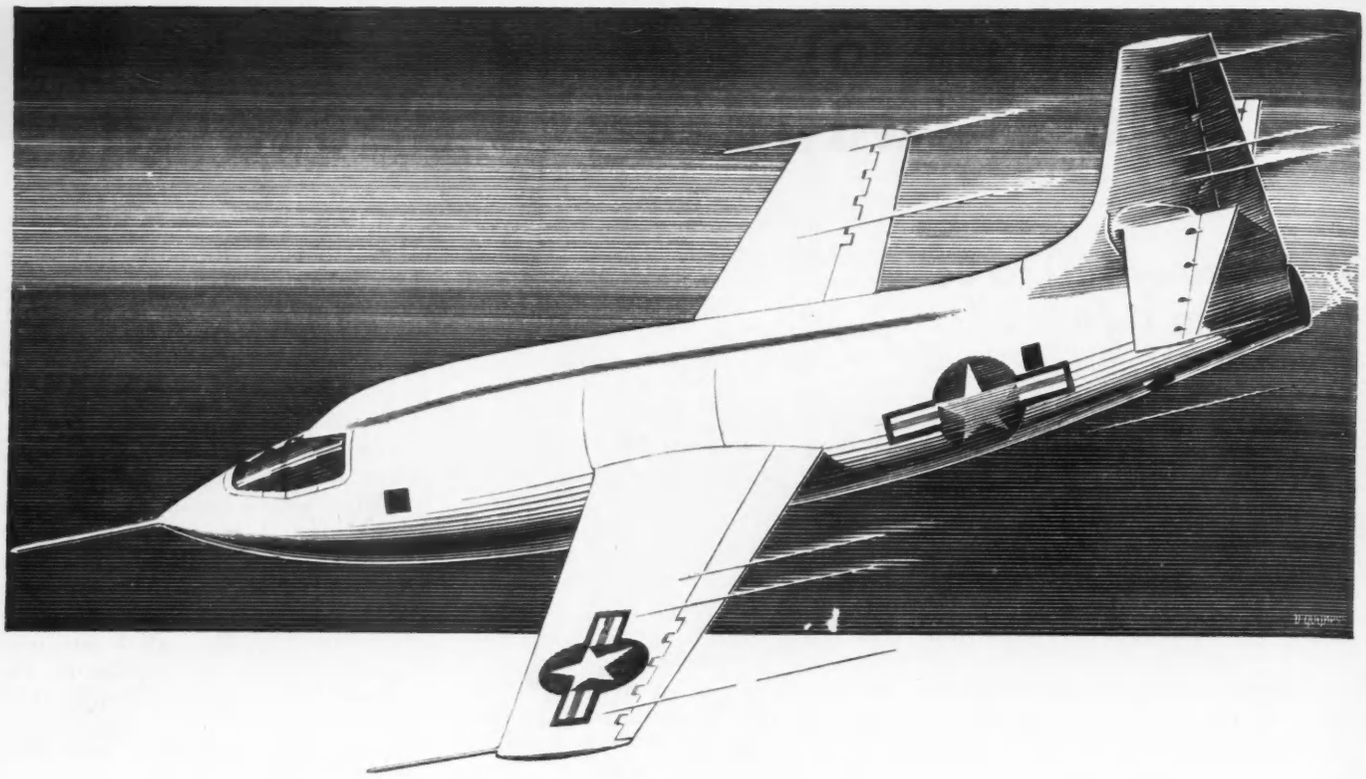
In the fall of 1950, natural gas also will be available for other gas distributing companies in New York, New Jersey, and Pennsylvania, upon completion of the 1800 mile pipe line of Transcontinental Gas Pipe Line Company from southern Texas to New York City.

Natural gas from the Southwest has been available to some Midwestern cities, including Chicago and Detroit, for a considerable number of years. The process for mixing natural gas with manufactured gas was developed by a Chicago gas distributing company.

While natural gas from Texas and adjacent states is finding large markets in the Eastern and Middle-Western states, is also is due to go in increasing volumes to California under projected pipe line expansion programs.

In the Southwestern and Southern States, too, larger markets for natural gas are being opened up through expansion and enlargement of gas distribution systems.

Construction expenditures scheduled by the natural gas industry for the five years 1948-1952 will total approximately $3 billion, of which nearly $2 billion will be spent on transmission lines and the remainder for production, underground storage, distribution, and other facilities. Total expenditures for 1949 will be about $800 million, including $555 million for transmission lines, both figures being higher than for 1948. In 1950, construction expenditures will be nearly as large as in 1949. These figures do not include substantial construction expenditures projected by the manufactured and mixed gas industries.



Penetrating farther and faster . . . with Jet

Modern engineering and precision workmanship produced this jet fighter after years of research and development. Flown by highly skilled, carefully trained men, it penetrates new horizons of speed and altitude.

The Welex Jet methods of casing perforating and Torpedo Jet blasting likewise reflect modern engineering and precision workmanship.

Time, money and experience were invested unstintingly in the development of this modern process by Welex, Byron Jackson Co. and E. I. Du Pont de Nemours & Co. The most exacting technical work was involved, but one by one the technical problems were mastered and improvements made until the present-day Welex Jet Process became a practical reality. Today, the Welex Jet Process is finding world-wide application in oil well casing perforating and open hole shooting. It gives you up to 300% greater penetration than any other practical method ever known, plus precision and safety never before attainable. Welex Jet Services offers you the benefit of experienced field crews carefully trained and supervised by the men who originated the Jet Process.

Phone the nearest Welex station for prompt service day or night. *Write for illustrated bulletin on Jet Processes.*

Licenses have been issued to leading servicing companies to render Jet Services to the Oil industry under the rights owned by Welex. A list of licensed companies is available upon request.

WELEX JET SERVICES, Inc.

3909 Hemphill Phone 4-3245 Fort Worth 9, Texas

Houston, Tex. Wichita Falls, Tex. Odessa, Tex. Ardmore, Okla. Lindsey, Okla. Caracas, Venezuela

Monthly News Analysis

SUPPLY-DEMAND BALANCE BRIGHTENS OUTLOOK . . . CRUDE DEMAND RISES
DEVALUATION FAVORS STERLING OIL . . . TIDELANDS SETTLEMENT DELAYED

Industry's Prospects Better For Remainder of This Year

The downward trend of petroleum industry operations during the first half of 1949 started a reversal in the third quarter with prospects that the industry as a whole will end the year with a balanced relationship between supply and demand.

Frank Abrams, chairman of the board of Standard Oil Company (N. J.), and Chester F. Smith, company vice president, see a sharp step-up in refinery runs and in demand for domestic crude oil during the fourth quarter of 1949. Smith estimates that for the U. S. east of California, 1949 demand for all products for the first eight months of 1949 has been only 1 percent below that for the corresponding period of 1948, and he predicts total 1949 demand will exceed that of 1948 by 2 percent. He expects that inventories, which in April were 55 million barrels above the level of a year ago, and which by August had fallen to 22 million barrels above 1948 levels, would reach a point no higher than the year-end inventories of 1948.

Smith judges that crude runs for the country east of California will increase 500,000 barrels daily above August levels in the fourth quarter of 1949 to meet anticipated demand for winter fuel oils. He also foresees a 6 percent to 7 percent rise in gasoline demand in 1950 above that for 1949.

Summer Discounts for Oil Tank Filling Unsuccessful

There is much doubt that future years will bring repeated use of price discounts to stimulate summer filling of consumers' heating oil tanks. Instead, the industry may find it desirable to try other means of avoiding trouble in meeting winter's peak demand, such as providing extra facilities. The discount plan was used in July and August. But its effect on heating oil purchases was limited, in the opinion of many jobbers, who question the advisability of any such artificial stimulus in an industry-wide marketing program. Some jobbers said, when the discounts expired at the end of August, that they hoped the plan would not be used again.

Lack of incentive for jobbers was one of the faults of the plan. Household consumers were offered a 0.5 cent discount, but the tank wagon operator had only a 0.1 cent incentive in July, when the wholesale discount was 0.6 cent, and no incentive for pushing sales in August, with the wholesale discount 0.5 cent.

Joseph B. Wells, executive director, Independent Oil Men's Association of New England, in the association's bulletin, said the plan caused confusion, much bookkeeping, and considerable consumer ill-will, with no added income to cover expense. Consumers could be expected to wonder, he said, why oil could be discounted 0.6 cent in July, only 0.5 cent in August, and then be increased rather than discounted in September.

Devaluation Expected to Have Adverse Effect on Dollar Oil

Devaluation of the British pound is expected to work adversely on dollar oil in favor of sterling oil. Biggest effect may be in slowing down of American operations in the Middle East.

Following the devaluation, it was reported that Britain planned to demand a share of the Saudi Arabia concession to increase the amount of sterling oil available from that area. American companies may be ready to accept the arrangement, since dollar oil has been sold to many unwilling customers because of lack of sterling oil for sterling bloc buyers.

Tendency may be for foreign purchasers to move out of dollar oil in the Middle East as rapidly as possible. This in turn might lessen significance of Middle East production for American firms and turn attention to Canada.

Devaluation will cut down still more the dwindling U. S. exports to the Eastern Hemisphere, and likely will promote sterling oil in world trade to the point where it may take away dollar markets in Europe and South America because of cheaper sterling price.

In general, devaluation of sterling bloc currencies in relation to the dollar permits Americans and others with dollars to get more pounds for those dollars and thus to get more pounds' worth of British and other goods. British exporters expected booming sales to the dollar market with their cheaper products, in stiffer competition with American industry for dollars. But British and others buying American goods must spend more pounds to get dollars to buy American goods and therefore will tend to import less.

In line with that general effect, devaluation will tend to make British oil companies more competitive with American companies, at least until the latter can get on a sterling basis in the European market. For British companies may make higher sterling profits, though their costs also will increase somewhat.

It was not clear whether devaluation would increase pressure to sell Middle East oil in the U. S., though this was conceded as possible. At the same time, it was recognized that the move could cause reduction of British buying of oil products in this country.

Devaluation of the Canadian dollar by 10 percent, which followed the devaluation of the British pound, was expected by drilling contractors to increase their costs on Canadian drilling by 10 percent on one-half of all materials used—those imported from the U. S. Wages for drilling crews also may advance.

Better Heating Oil Prices Improve Refiners' Margins

Reasons given for increases in kerosine and heating oil prices along the Atlantic Coast in late August and September included need for better margins for refiners and necessity of paying higher prices for adequate supplies from the Gulf Coast.

"Adjustments were made," stated Socony-Vacuum Oil Company, "to improve the shrunken and uneconomic refinery margins. There was also the necessity of assuring adequate supplies to meet anticipated increases in demand. Cost to the company at the Gulf of such of these oils as it purchases to supplement its output has risen sharply." The company on September 8 announced a general advance in its kerosine and No. 2 fuel prices for all methods of delivery, at most points in New York state and New England. Kerosine was raised 0.1 to 0.6 cent per gallon, and No. 2 fuel oil 0.1 to 0.8 cent. On August 17 Socony-Vacuum had advanced No. 2 prices by amounts ranging from 0.3 to 0.6 cent.

Esso Standard Oil Company effective September 14 advanced its prices for kerosine, heating oils, and other distillate fuels in amounts varying up to 0.6 cent

per gallon, all methods of delivery. The company markets in most states north of Georgia in the East. The company explained that: "During the late spring and summer the low prices obtainable for burning oils and the consequent inadequate refinery operating margins resulted in reduced refinery runs and low distillate yields. It is necessary that refinery runs be stepped up now and distillate yields increased materially above the current low levels to take care of anticipated peak demand of a normal winter. These new prices, although substantially lower than the prices that were in effect a year ago, should tend to bring out the additional supplies required." Most other suppliers in Middle Atlantic states followed with similar increases. Some East Coast suppliers also increased No. 4 fuel oil 8 cents a barrel and No. 5 fuel oil 4 cents, though No. 6 fuel oil was not changed.

October Allowables Reflect Increasing Demand for Crude

The anticipated increase in crude production for the latter part of this year is materializing, as raising of allowables which started September 1 has been extended, with October allowables further increased.

The Texas Railroad Commission ordered an average allowable of 2,135,238 barrels daily for October, an increase of 32,044 barrels over the September average, which had been somewhat above August. September 1 had brought small allowable increases also in Kansas and Louisiana.

Under the new Texas allowables, all fields except those producing heavy asphaltic crudes will get one more producing day in October than in September —19 days for most fields and 17 days for East Texas field in October. The U. S. Bureau of Mines had estimated market demand for Texas crude in October would be 2,190,000 barrels daily, up 60,000 barrels from its September forecast.

British-American Oil Talks Complicated by Devaluation

So sharp has become the difference between Britain and the U. S. on worldwide petroleum policy issues that Washington threatens to cut off all further dollar aid for the development of the British oil industry. At the recent British-American trade and monetary conference in Washington, the British delegation tried to minimize the role of oil in Britain's recovery program, but the petroleum problems were finally dragged out in the open on the insistence of American participants. Separate oil talks were scheduled after the close of the regular conference, and the issue of dollar-sterling convertibility was raised, one of the most important of the entire conference.

However, only a few days after the oil talks were started, they were seriously complicated by the world-disturbing devaluation of the British pound, and it was indicated that the conversations might be suspended until devaluation's effect on oil could be better analyzed.

Before the petroleum conversations got under way, Britain's assumptions were clear: (1) Further U. S. dollars should be made available for the development of the British oil industry; (2) British oil should be allowed to compete—and even displace—dollar oil in world markets; (3) dollar oil itself should not be allowed full competitive advantage against sterling oil.

Numerous industry observers feared the results of the concession made by the U. S. at the original conference when this country agreed to waive temporarily Article 9 of the 1946 Anglo-American loan convention, thus permitting Britain to discriminate in specific instances against American goods. Since petroleum is Britain's single greatest natural resource, it is feared that the brunt of such a discriminatory policy will fall on the American oil industry.

One top authority in the American industry commented: "Britain wants permission, of course, to secure as much of the world's oil markets as she can. With the exception of Scotch whiskey, petroleum is the most strategic export commodity available to any country, and the best source of dollar exchange. The British argue they must either have more Marshall Plan aid or win some circumstantial advantage for their own export trade program as a recovery means. More Marshall Plan aid is now highly unpopular, so it's more political to take it out of the hide of the oil companies."

Another policy-level official of a major company said: "The British contend they must be allowed to establish a favorable British trade position in the world in order to save U. S. dollars. While this argument holds up to a point, it falls beyond that point. The foreign market is expanding rapidly. For the British to maintain their share of this market, it is necessary for them to expand production and refining facilities, as they are doing. But if we cut back our facilities, then the British would have to expand to the point of picking up our losses as well. That is, they would have to supply increased oil requirements in dollar areas as well as sterling. This would result in a wasteful expenditure of dollars for such a production-refining buildup, and hence would defeat the British purpose by working against the balance of payment program.

"Any real help we can give the British lies only up to the point where we assist them to take care of their own natural market increment, but not to encourage them to substitute projected, still unbuilt plants for our facilities while we cut back our own facilities. If we are frozen out of world markets, the British ultimately are worse off than if they had used our existing capacity to supply their markets."

Residual Imports Attacked But Also Defended As Need

The fight of Independent Petroleum Association of America against imports recently has centered particularly on the bringing in of residual fuel oil. The association charged that residual imports have displaced domestic supplies and demoralized domestic markets. But this charge was countered by Standard Oil Company (N. J.) with the assertion that residual imports have supplemented and not supplanted domestic oil.

"It is in the market for heavy fuel oil," stated IPAA's committee on supply and demand in its report for September, "that imports have their greatest and most direct effect, as imports consist largely of heavy fuel oil or crude oil with a relatively high heavy fuel oil content. The increase in these imports has demoralized the heavy fuel oil market to the extent that domestic supplies of this fuel are unable to compete and domestic production has been greatly discouraged and restricted. At the same time, conversions from coal to heavy fuel oil have been stimulated. Domestic producers and refiners of domestic crude oil have been seriously injured by this development, which has forced the domestic industry to suffer heavy losses and relinquish this market outlet to those few companies having access to foreign oil. Paradoxically, there have been threats of shortages of this product in the face of the shut-in capacity to produce and refine heavy fuel oils in this country. It is essential that these unsound conditions be recognized as the direct result of excessive imports during the past year."

Jersey Standard issued a memorandum asserting that imports of residual fuel oil have been "supplementary to domestic production and stocks—they did not supplant domestic production." The memorandum was intended to combat use of residual import figures in combination with crude import figures to claim that the total is taking the place of domestic crude production.

East of the Rockies, domestic refiners have sold more residual fuel oil than they have produced since the beginning of 1949, declared the memorandum. Furthermore, domestic refiners will not buy additional crude to produce more residual, the memorandum stated.

Crude oil prices would have to be far

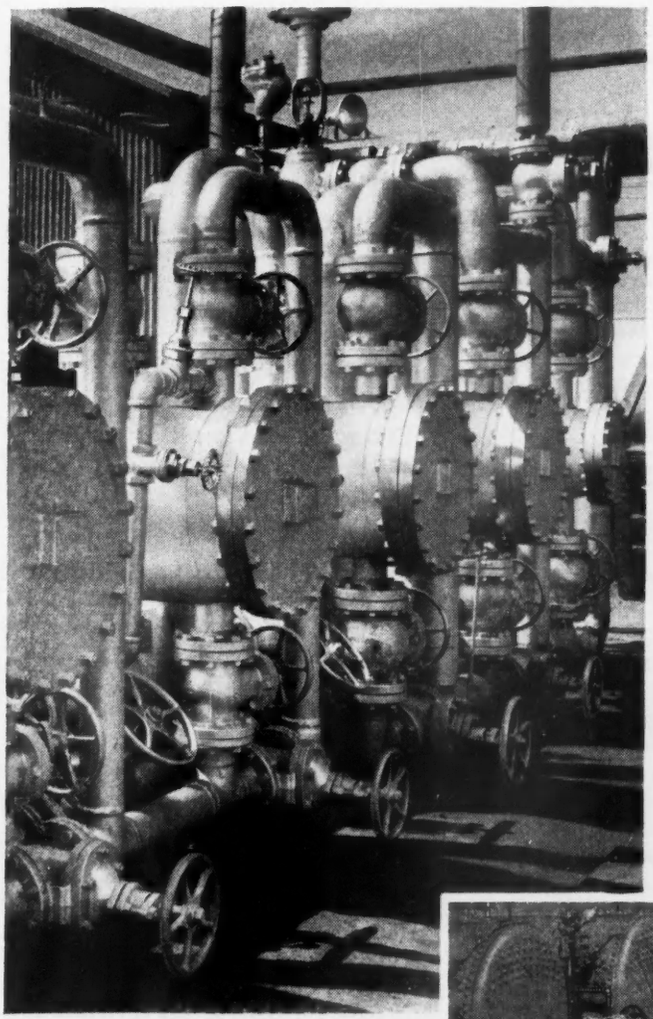
To satisfy every piping equipment need ... look to the CRANE line

ONE SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

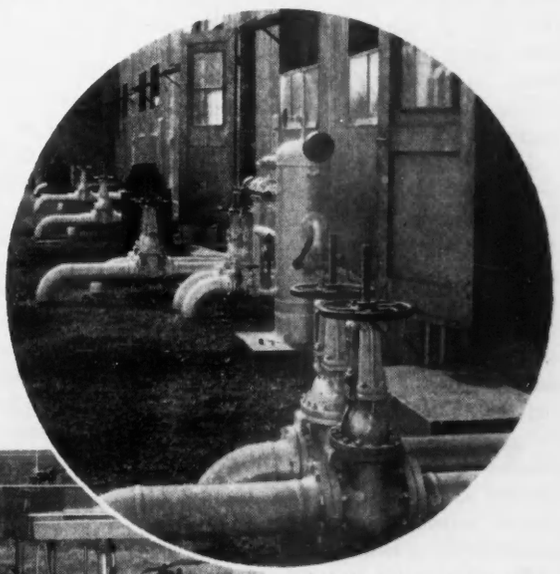
When you look to Crane *first,* you eliminate the need for further search. Everything you need for the job ... valves, fittings, pipe and pipe line accessories ... is there, in one complete line. You get better distribution service, too, when you "get everything from Crane." Local Branches and Wholesalers—all backed by large factory stocks—are well equipped to supply your day-to-day piping requirements.

To rely on this **Single Source of Supply** is to simplify every piping procedure, from design to erection to maintenance work. **Complete Responsibility** on Crane for materials assures better installations, avoids needless delays. And by choosing the **High Quality** that is Crane Quality, you help yourself to dependable performance from every piping item in your entire system.

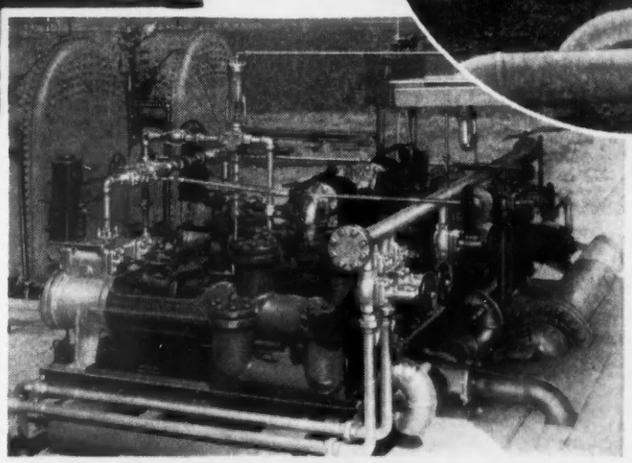
CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



HEAT EXCHANGER BANK *in recycling plant using Crane 125 and 250-Pound iron body wedge gate valves, flanged, screwed and welding piping materials.*



INTAKE LINES *to compressor house featuring Crane 6-in. iron body gate valves.*



BOILER FEED PUMP UNIT *equipped with Crane 600-Pound small steel gate valves.*

EVERYTHING FROM ...

VALVES
FITTINGS
PIPE

CRANE

PLUMBING
AND
HEATING

FOR EVERY PIPING SYSTEM

below present levels in order for domestic residual to become a primary product instead of a by-product, according to the memorandum. "However, if crude oil prices dropped enough for residual production to become profitable, the finding and development of new oil reserves would practically cease. The maximum efficient productive capacity of the industry would decline rapidly and would soon be inadequate to meet even present needs, not to mention the increased needs of the full residual market. In other words, it is economically impossible for domestic residual to be other than a by-product for any appreciable period."

There are now in evidence four long-term trends which point to "lower and lower yields of residual fuel oil from domestic refineries in all areas," according to the memorandum. They were listed as follows: (1) Probable higher crude oil prices in the future because of higher cost of finding new reserves; (2) the rapid expansion of natural gas supplies in practically all areas having sizable fuel requirements; (3) the rapid installation of diesel locomotives on the railroads to replace residual burning, as well as coal burning locomotives; and (4) the considerable advances which have been made, and which probably will continue, in reducing costs of converting residual fuel oil to other products of higher market value.

D. W. Hovey, Houston, president of Gulf Coast Refiners' Association, replied to the Jersey. Standard memorandum. He asserted that imported residual fuel oils must be considered as imports of petroleum. "These imports have pushed residuals of American refiners out of their markets," he said, "and by creating an oversupply, have cut the price far below the price of crude." Hovey cited prices of $2.46 to $3.20 a barrel for Bunker C fuel oil on the Gulf Coast September 2, 1948, with crude at about $3 a barrel, showing the fuel oil as not a by-product. Then Bunker C on September 2, 1949, after many months of heavy imports, was $1.35 to $1.50, with crude prices unchanged and the fuel oil now an unprofitable "by-product." The change was caused by oversupply created not by overproduction of domestic refineries but by imports of distress residuals, for which there is no foreign market at any price, Hovey charged.

Krug Still Seeks Funds for Commercial Oil-Shale Plant

Secretary of Interior Krug told the United Nations conference on natural resources that he still is seeking an appropriation for a commercial oil-shale plant in Colorado, although "oil and coal interests have blocked it in Congress so far."

Krug said that the government's pilot plant at Rifle, Colo., recently attained production of diesel oil and jet engine fuel at costs "approaching commercial rates." He said gasoline will be produced at the Rifle plant soon.

Surplus of Heavy Fuel Oil Is Problem in California

Although residual fuel oil supply and demand have been fairly well balanced east of the Rockies, a troublesome surplus has remained in California. Seriousness of the California problem has been emphasized during the past month by market developments, including price reductions on residual and heavy crudes and disclosure of plans of Union Oil Company of California to ship 2 million barrels of Bunker "C" fuel oil to New York and other eastern ports during the coming fall and winter. The company heretofore has not made such volume shipments to the East Coast for about 15 years. There were also reports of negotiations by some independent companies for similar sales of several million barrels of California residual for delivery on the East Coast. Tanker transportation cost from California to the Northeast Coast is 70 or 80 cents a barrel. With that cost deducted from the prevailing market price of residual at New York, shipments from California net the sellers less than $1 per barrel, or less than the market price in California even after the early September cut in the posted price of residual in California.

On the Gulf Coast the price of Bunker "C" fuel oil has been about $1.45 per barrel and in New York about $1.70. In California the price was about $1.60 per barrel, but in early September it was cut by major marketers by 35 cents to $1.25 per barrel.

Effective September 1, Union Oil initiated the 35-cent cut in the price of heavy fuel oil "in order that the company's posted price might accurately reflect fuel oil market conditions here on the coast. With heavy fuel oil in long supply, a considerable volume has been moving at under the previously posted prices."

The price cut by Union Oil precipitated a general round of price reductions by other companies, not only of fuel oil, but in the posted prices paid for heavy crudes. Standard Oil Company of California on September 3 announced crude price reductions ranging from 3 cents per barrel for oil of 25 gravity to 35 cents for oil of 14 gravity and under. Shortly afterward, similar reductions were announced by other major California purchasing companies. This cut brings prices of 14-gravity crude in most San Joaquin Valley areas down to lows of $1.07 to $1.20, depending on the field and type of crude. In the rapidly developing, shallow Newhall Placerita field, where there has been excessive flush production, General Petroleum Corporation, major purchaser, on September 5 cut postings 13 to 90 cents a barrel. The average 22-gravity crude was cut 81 cents from $2.13 to $1.32 per barrel.

Because supplies of residual fuel oil have materially exceeded demand in California, large volumes have been going to storage in 1948 and 1949. The surplus is largely due to the high proportion of lower gravity crude produced in California fields.

Surplus residual is expected to be a continuing problem, although relief should be afforded by several factors. Lower prices of heavy crude and residual have caused shutting in of some heavy crude production and have stimulated demand for residual. West Coast refiners are installing secondary refining equipment to convert residual partially into lighter products but will need several years to complete such projects.

Settlement of Tidelands Question to Be Delayed

Settlement of the controversial tidelands issue is now conceded to be impossible until after ruling by the Supreme Court in 1950 on the new suits filed against Texas and Louisiana. The Administration, including Interior Secretary Krug and Solicitor General of the Justice Department Perlman are standing pat for enactment of the stringent federal control bill (S-923) introduced by Senator O'Mahoney of Wyoming last February.

Krug particularly has refused all support to the "states' rights bill" (HR 5991) developed in attempt to compromise the positions of the federal government and the states into some workable harmony plan. Krug predicts that a Presidential veto awaits any bill except the strict federal control measure.

Krug estimated at a hearing of a House Judiciary Committee that submerged oil deposits off the Texas and Louisiana coasts amount to 13 billion barrels, and off the California coast, 2 billion barrels.

Hall Hammond, Maryland attorney general and chairman of the submerged lands committee of the National Association of Attorneys General, argued the states' case before the House committee, saying the states have not abandoned their goal of compelling outright surrender of federal claims to the coastal lands. He said the states would not accept the federal contention for exclusive control.

Walter S. Hallanan, chairman of the National Petroleum Council, said oil companies operating in the tidelands have received gross revenues of only $900,000 from an investment of $192 million, or less than one-half of 1 percent.

The Wiggins Lodek Floating Roof

. . . designed specially for the storage of corrosive oil products. The entire under surface being in complete contact with the tank contents, no vapors are trapped or can collect beneath the roof.

The basic exclusive conservation features of the Hidek Roof including the triple seal and extra large pontoons are retained.

Write for bulletin FR-3 which gives further details on Wiggins Lodek Floating Roofs.

WIGGINS
CONSERVATION STRUCTURES

Hidek Floating Roof
Dry Seal Lifter Roof
Improved Breather Roof
Lodek Floating Roof
Dry Seal Gasholder
Improved Balloon Roof

GENERAL AMERICAN TRANSPORTATION CORPORATION

WIGGINS VAPOR SEALS — GENERAL AMERICAN — TRADE MARK

135 SOUTH LA SALLE STREET, CHICAGO 90, ILLINOIS

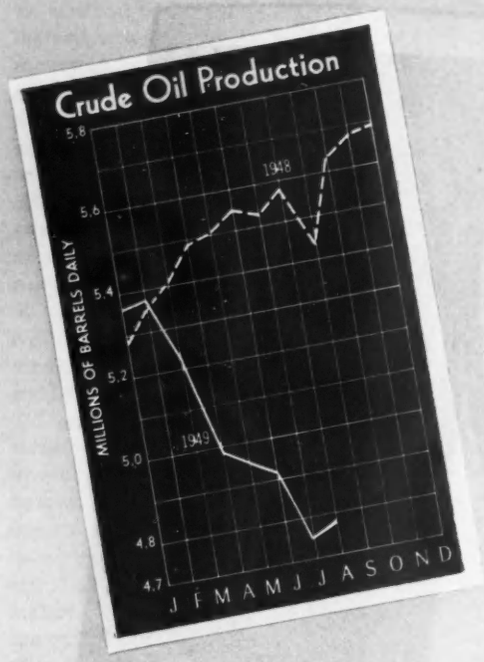
BRANCH OFFICES: New York • Washington, D. C. • Cleveland • Buffalo • Pittsburgh • St. Louis
New Orleans • Tulsa • Dallas • Houston • Seattle • Los Angeles • San Francisco

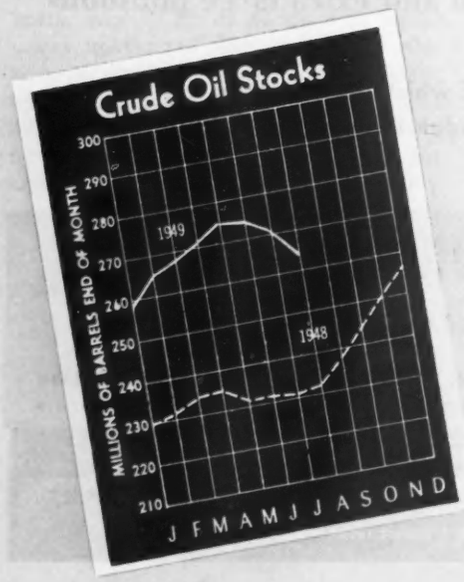
Sub-licensees

WESTERN STATES: Consolidated Western Steel Corporation, San Francisco — Los Angeles
SOUTHERN STATES: Wyatt Metal and Boiler Works, Houston — Dallas, Texas • CANADA: Toronto Iron Works Ltd., Toronto
GREAT BRITAIN: Motherwell Bridge & Engineering Co., Ltd., Scotland
FRANCE: Etablissements Delattre & Frouard réunis, Paris

August Crude Production Is

By CECIL W. SMITH,





BOTH crude production and refining took upward turns during August to present a considerably brighter picture than has been the case in the past few months. Gasoline production was slackened in favor of the soon-to-be needed domestic fuel oils, and crude stocks, after building to burdensome levels, were dropped back almost to the point considered by many industry economists to be a proper working level.

Gasoline stocks have been running higher than demand actually required because of the higher price brought by that product. It was beginning to appear that refiners might not start upping domestic fuel oil yields in time to amply meet the increased needs expected this winter. However, the shift did come in August as gasoline output was cut back and the light heating oils were boosted.

The more attractive price of gasoline has been the main, but not the only, reason for the hold-off on fuel oil production, for delayed buying by consumers has caused these oils to begin to stack up at the refineries. Because of this condition, the frantic buying that is sure to come with the first cool weather could very well leave some burners cold temporarily. Various plans have been tried to tempt consumers to lay in supplies during warm weather, but all have met with mediocre success. Had they worked, stocks would have moved out of refinery storage, but users are reluctant to tie up their money before their needs start and choose to vie with others in the wild scramble for available supplies. Then the industry's problem becomes not so much one of supplies, but one of transportation.

Crude production in August was raised 30,000 barrels a day on the average from July's daily output, but still was 809,000 barrels a day under that of August, 1948, when production was very high in order to build up crude stocks. Now that stocks are being drained off after going too high, a comparison of present production against last year's is not a very good one.

Texas alone accounted for the nation's increased crude output during August by hiking its daily production 34,000 barrels to a total of 1,870,500

Crude Oil and Refined Products Trends
(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1948:									
January	5,283	5,348	229,842	2,328	102,167	1,082	39,788	1,278	36,260
February	5,353	5,380	231,419	2,264	110,999	1,127	33,019	1,295	35,602
March	5,406	5,387	234,164	2,252	111,949	1,050	30,570	1,307	34,192
April	5,484	5,540	234,506	2,396	109,289	978	32,564	1,303	35,527
May	5,502	5,668	231,318	2,486	108,552	992	38,551	1,314	41,123
June	5,544	5,632	231,412	2,529	104,518	998	45,835	1,280	44,213
July	5,522	5,631	230,955	2,494	98,839	994	56,045	1,264	49,448
August	5,577	5,621	231,954	2,532	95,445	1,038	65,887	1,248	55,009
September	5,435	5,376	237,302	2,416	90,518	961	73,854	1,154	58,682
October	5,632	5,594	243,972	2,490	92,426	1,069	79,992	1,268	61,456
November	5,675	5,672	250,066	2,551	95,589	1,081	80,658	1,277	64,865
December	5,688	5,720	256,254	2,626	103,697	1,106	71,475	1,299	64,021
1949:									
January	5,365	5,641	258,648	2,538	116,621	1,063	61,584	1,348	62,508
February	5,376	5,480	265,216	2,484	126,054	1,004	53,937	1,282	59,398
March	5,224	5,352	269,341	2,470	127,443	933	48,923	1,258	58,190
April	5,012	5,141	272,520	2,494	125,351	846	51,231	1,147	59,668
May	4,972	5,195	273,912	2,585	121,602	813	57,442	1,138	63,576
June	4,903	5,162	274,691	2,597	114,041	771	64,730	1,041	64,628
July	4,738	5,172	271,387	2,609	109,747	839	71,070	1,084	67,182
August	4,768	5,221	264,546	2,591	105,454	886	75,696	1,055	68,167
August, 1949: Changes:									
In Month	+30	+49	−6,841	−18	−4,293	+47	+4,626	−29	+985
In Year	−809	−400	+32,592	+59	+10,009	−152	+9,809	−193	+13,158

Trends

Raised 30,000 Barrels Daily

Statistical Editor

barrels. Smaller increases in Kansas, Illinois, and Louisiana offset drops in California, New Mexico, Oklahoma, and several others. Early reports show that production has continued to rise in September, and most of the governed oil states have announced that another gain will be made in October.

U. S. refineries processed 5,221,000 barrels of crude a day during the month to top July's runs by 49,000 barrels a day, but were still 400,000 a day under runs of a year ago. August's refinery activity was at the highest point since March of this year.

Withdrawals totaling 6,841,000 barrels were made from crude stocks in August to lower the grand total to 264,546,000 barrels, which was their lowest level since last January. These stocks had reached an excessive 275 million barrels, but at the end of August they were approaching the 260 million barrel mark believed by many industry observers to be the proper working level.

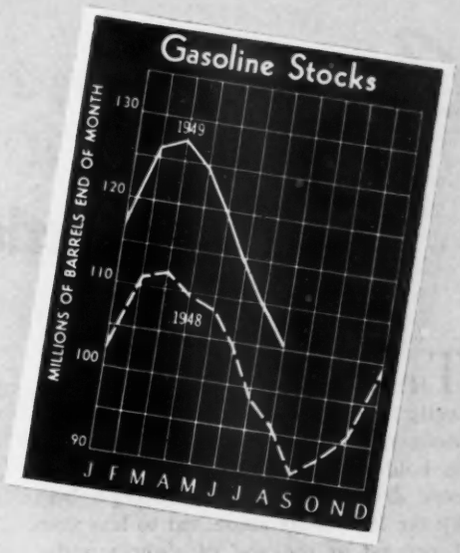
Despite increased refinery runs, gasoline production was lowered 18,000 barrels a day, while distillate fuel output was upped 47,000 barrels, showing the swing to higher fuel oil yields.

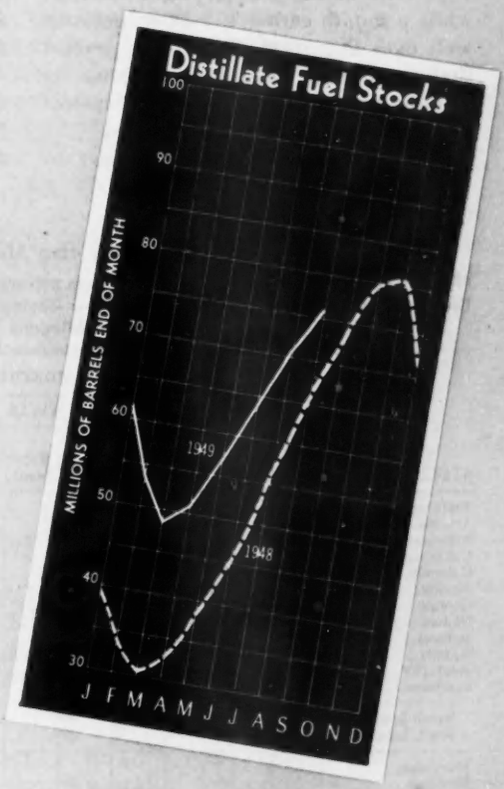
Stocks of the two products responded very favorably to the change with gasoline dropping 4,293,000 barrels and distillate gaining 4,626,000. They both ended the month about 10 million barrels over last year's totals.

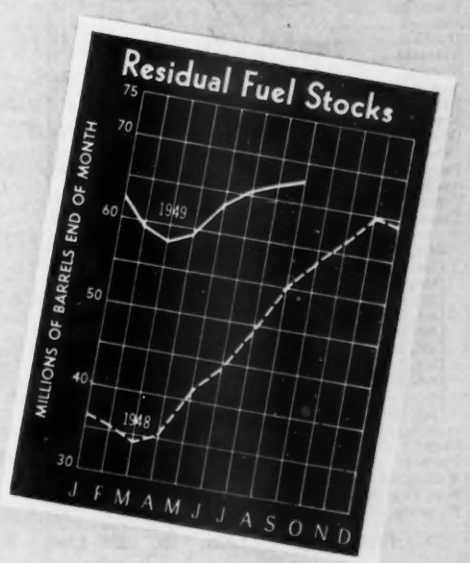
State Crude Oil Production

(THOUSANDS OF BARRELS)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL FIRST EIGHT MONTHS		
	August, 1949	July, 1949	August, 1948	% Diff. August, '48-'49	1949	1948	% Diff. '48-'49
Alabama	1.2	1.2	1.3	— 7.7	291	311	— 6.4
Arkansas	76.9	76.4	86.8	— 11.4	20,042	20,974	— 4.4
California	903.3	909.4	949.8	— 4.9	225,940	229,969	— 1.8
Colorado	66.2	66.6	46.6	+ 42.1	15,914	11,203	+ 42.1
Florida	1.5	1.4	0.8	+ 87.5	321	191	+ 68.1
Illinois	183.8	180.2	180.9	+ 1.6	42,894	42,728	+ 0.4
Indiana	27.5	27.1	18.6	+ 47.8	6,097	4,038	+ 51.0
Kansas	252.6	245.8	310.4	— 18.6	67,581	73,095	— 7.5
Kentucky	23.0	23.4	22.8	+ 0.9	5,554	5,692	— 2.4
Louisiana	499.1	493.1	503.8	— 0.9	125,053	118,936	+ 5.1
North Louisiana	116.6	110.8	119.5	— 2.4	29,240	28,540	+ 2.5
South Louisiana	382.5	382.3	384.3	— 0.5	95,813	90,396	+ 6.0
Michigan	42.0	43.7	47.0	— 10.6	10,743	11,045	— 2.7
Mississippi	100.0	98.4	129.7	— 22.9	25,793	29,952	— 13.9
Missouri	0.1	0.1	0.2	— 50.0	28	36	— 22.2
Montana	24.7	25.5	26.8	— 7.8	6,239	6,172	+ 1.1
Nebraska	0.5	0.6	0.6	— 16.7	150	159	— 5.7
New Mexico	123.5	134.5	132.5	— 6.8	32,147	31,486	+ 2.1
New York	13.7	13.9	12.6	+ 8.7	3,007	3,092	— 2.7
Ohio	9.7	9.9	9.5	+ 2.1	2,317	2,187	+ 5.9
Oklahoma	378.2	380.1	424.0	— 10.8	99,629	100,706	— 1.1
Pennsylvania	29.0	27.5	34.6	— 16.2	7,566	8,506	— 11.1
Tennessee	.....	.....	.....	.....	5	5	.....
Texas	1,870.5	1,836.8	2,475.8	— 24.4	495,516	594,253	— 16.6
Dist. 1—South Central	25.9	25.7	29.0	— 10.7	6,397	6,587	— 2.9
Dist. 2—Middle Gulf	115.0	112.0	179.0	— 35.8	32,131	42,239	— 23.9
Dist. 3—Upper Gulf	355.1	351.1	493.5	— 28.0	96,561	120,609	— 19.9
Dist. 4—Lower Gulf-SW.	181.1	178.3	250.4	— 27.7	48,056	61,859	— 22.3
Dist. 5—East Central	32.5	32.5	49.1	— 33.8	9,226	11,248	— 18.0
Dist. 6—Northeast	307.3	305.7	424.8	— 27.7	85,981	105,026	— 18.1
Dist. 7-B—N. Central	57.8	57.6	50.9	+ 13.6	14,560	11,265	+ 29.2
Dist. 7-C—W. Central	42.8	41.5	43.7	— 2.1	10,831	10,766	+ 0.6
Dist. 8—West	521.4	501.4	703.4	— 25.9	138,364	166,199	— 16.7
Dist. 9—North	137.5	137.2	138.0	— 0.4	32,196	33,958	— 5.2
Dist. 10—Panhandle	94.1	93.8	86.1	+ 9.3	21,987	21,100	+ 4.2
Utah	1.8	1.3	.....	.....	157	.....	.....
Virginia	0.1	0.1	.....	.....	26	25	+ 4.0
West Virginia	8.0	7.9	7.5	+ 6.7	1,844	1,780	+ 3.6
Wyoming	131.4	133.5	154.4	— 14.9	30,995	35,552	— 12.8
Total United States	4,768.3	4,738.4	5,577.0	— 14.5	1,225,849	1,332,093	— 8.0







Completions

Lead 1948 Period in Footage

THE industry completed a few more wells in August than it did in the previous month to enable the year's total to hold a slim lead over last year's record drilling activity. The margin held by the 1949 wells amounted to less than 1 percent at the end of eight months, while a month earlier the difference was well over 2 percent. It appears certain that the present year will relinquish its drilling supremacy by the time September's completed wells are counted.

Although 1949 will probably have to play second fiddle to 1948 as far as total wells drilled is concerned, there seems little possibility that this year will fail to turn in the greatest amount of footage ever drilled. So far this year each new well has averaged 150 feet deeper than last year's and total footage now holds a lead of about 4.5 percent over the 1948 total.

August's completed wells totaled 3371 to show a slight gain over July's 3336, but they were far short of the 3811 drilled in August, 1948. Partly responsible for August's small increase was an appreciable drilling step-up in Pennsylvania and New York, where activity had been drastically cut. Oklahoma likewise contributed to the gain, but a drop of 100 wells in Texas prevented the U. S. as a whole from showing much of an increase.

At the end of eight months wells totaled 25,464, a scant lead of 0.4 percent over the 25,372 drilled in the same period of last year. At the end of June the difference had been more than 4 percent in the current year's favor, and by the end of July that lead had been whittled to 2.5 percent.

The same is not true for footage drilled in these wells. So far 4 million feet more have been drilled this year than in 1948, and this lead is not likely to be lost. New wells in 1949 have averaged 3604 feet each, while a year ago they were carried to 3459 on the average.

Well Completions in the United States during August, 1949, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from *The Producers Monthly.*)

STATE or DISTRICT	MONTHLY COMPLETIONS, AUGUST, 1949 — NEW WELLS: Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	TOTAL COMPLETIONS: Aug., 1949	July, 1949	Aug., 1948	Footage August, 1949	CUMULATIVE TOTAL: Wells 1949	Wells 1948	Percent Diff.	Footage 1949	Rigs in Operation (Drilling, Rigging Up and Shut Down): Aug. 31, 1949	July 31, 1949	Aug. 31, 1948
Alabama	1							1		1	4	2	3,282	11	13	— 15.4	57,941	3	2	2
Arizona											1			4	1	+300.0	11,496	5	6	6
Arkansas	7			24				31		31	29	31	157,794	211	208	+ 1.4	883,485	31	27	40
California	112		1	50				163	6	169	176	261	742,962	1,700	1,752	— 3.0	6,810,401	265	232	305
Colorado	5			4				9	1	10	7	17	57,416	45	159	— 71.7	200,503	17	20	51
Florida	1			1				2		2	1	3	16,407	12	19	— 36.8	77,278	4	4	6
Georgia												1		4	3	+ 33.3	12,437	1	1	
Illinois	111			134				245		245	286	216	573,560	1,641	1,525	+ 7.6	4,054,402	237	221	260
Indiana	49		1	71			1	122		122	136	94	212,136	789	663	+ 19.0	1,477,120	164	156	137
Kansas	132		51	91			5	279		279	308	314	903,573	1,951	1,984	— 1.7	6,497,482	280	300	253
Kentucky	29		24	35				88		88	87	77	160,385	595	516	+ 15.3	1,075,922	93	88	78
Louisiana	140	7	31	62				240	1	241	224	221	1,101,111	1,453	1,441	+ 0.8	8,059,178	196	208	219
North Louisiana	101	3	30	45				179	1	180	137	147	545,699	841	922	— 8.8	2,733,717	60	69	74
South Louisiana	39	4	1	17				61		61	87	74	555,412	612	519	+ 17.9	5,325,461	136	139	145
Maryland															1	—100.0				
Michigan	30			30				60		60	69	72	127,928	579	469	+ 23.5	1,304,455	136	123	127
Mississippi	13	1		16				30		30	21	46	207,827	228	277	— 17.7	1,677,538	33	28	49
Missouri	2							2		2	5	7	938	14	38	— 63.2	7,002	5	6	7
Montana	10		5	12				27		27	44	29	55,424	168	198	— 15.2	433,195	52	54	53
Nebraska				2				2		2			7,645	4	1	+300.0	14,754	3	3	2
Nevada																			1	1
New Mexico	30		4	9				43	2	45	23	49	203,049	346	416	— 16.8	1,501,303	91	86	107
New York	46		1		29			76		76	24	181	107,969	667	1,197	— 44.3	941,265	103	72	214
North Dakota																		3	3	
Ohio	28		32	48				108	4	112	76	129	228,042	707	860	— 17.8	1,527,983	164	155	215
Oklahoma	231	1	17	156				405	12	417	356	422	1,455,080	2,832	2,729	+ 3.8	10,126,523	499	457	558
Pennsylvania	72		31	18	51	16		188		188	129	313	349,740	1,399	2,180	— 35.8	2,508,847	264	208	433
South Dakota											1			2	1	+100.0	6,905	3	2	1
Tennessee	1			3				4		4			9,113	18	32	— 43.8	23,489	6	6	18
Texas	722	11	25	348		1	2	1,109	15	1,124	1,224	1,165	4,535,760	9,342	7,803	+ 19.7	38,694,131	1,150	1,209	1,382
Dist. 1—S. Central	22			27				49	1	50	47	34	154,995	385	312	+ 23.4	1,145,732	34	34	33
Dist. 2—Middle Gulf	22	4	4	23				53	1	54	58	61	322,742	443	506	— 12.5	2,598,046	50	49	64
Dist. 3—Upper Gulf	58	5	1	51				115	1	116	118	109	622,928	899	711	+ 26.4	5,444,480	110	114	124
Dist. 4—Lower Gulf-SW	40	2	7	36				85	2	87	103	134	453,701	920	916	+ 0.4	4,570,440	98	96	108
Dist. 5—E. Central	1			8				9		9	15	28	35,858	141	145	— 2.8	659,924	15	21	30
Dist. 6—Northeast	58		3	11		1	1	74		74	62	36	327,152	619	254	+143.7	2,702,362	41	49	35
Dist. 7-B—N. Central	71		3	79				153	1	154	176	165	443,640	1,291	923	+ 39.9	3,840,258	160	170	190
Dist. 7-C—W. Central	28			11				39	2	41	50	42	170,143	301	269	+ 11.9	1,403,832	82	61	71
Dist. 8—West	223			22				245	6	251	246	288	1,194,475	1,902	1,926	— 1.2	9,312,083	324	365	459
Dist. 9—North	149		2	77			1	229	1	230	282	216	623,566	1,731	1,485	+ 16.6	4,712,506	140	150	118
Dist. 10—Panhandle	50		5	3				58		58	67	52	186,560	710	356	+ 99.4	2,304,468	96	100	150
Utah	2			4				6		6	6	2	26,492	37	15	+146.7	175,007	14	15	12
Virginia															1	—100.0				
Washington															2	—100.0				
West Virginia	3		27	8				38	2	40	46	77	102,743	308	529	— 41.8	889,327	231	228	380
Wyoming	25		1	23				49	1	50	53	82	249,560	397	339	+ 17.1	1,855,349	90	95	142
Total U. S.	1,802	20	251	1,149	80	17	8	3,327	44	3,371	3,336	3,811	11,595,936	25,464	25,372	+ 0.4	90,904,718	4,143	4,016	5,058

Looking Ahead

BRITAIN'S DEVALUATION of pound is expected to have long-range effect of making British oil companies more competitive with American companies. Increased pressure to sell Middle East oil in U. S. is doubted by some but regarded as possibility by others. Devaluation also could eventually reduce British buying of oil products in U. S.

ESTABLISHMENT OF OIL import quotas is to be sought through separate legislation, following Senate's 41 to 40 vote defeating Thomas amendment to reciprocal trade agreements bill, along with all other amendments. Senate passed that bill in same form as approved by House. Thomas amendment would have limited oil imports to 5 percent of domestic demand. After close defeat of his amendment, Senator Thomas of Oklahoma was expected to introduce separate bill for quotas on oil imports.

TOTAL U. S. IMPORTS of petroleum are expected to average at least 610,000 barrels daily in this year's fourth quarter and thereby set an all-time record. Plans of importing companies indicate crude imports will average 430,000 barrels daily and receipts of refined products are estimated at 180,000 daily. Total imports averaged 581,000 barrels daily in the fourth quarter of 1948, 600,000 daily in first quarter of 1949 and 607,000 daily in second quarter of 1949.

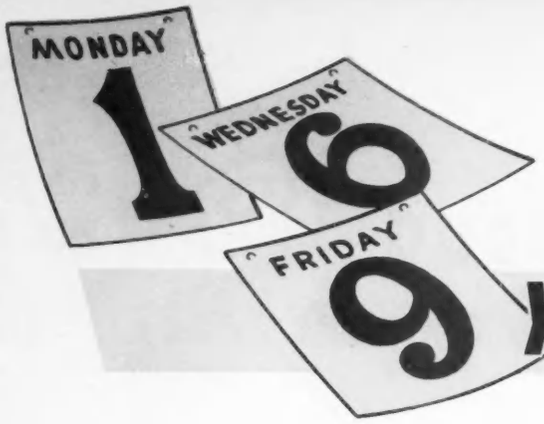
ABOUT 43,298,000 automobiles, trucks, and busses will be registered in U. S. by end of year, an increase of 6.6 percent over last year's total, estimates Bureau of Public Roads. Estimate does not include publicly owned motor vehicles, of which 529,062 were registered during 1948.

FULL-SCALE INVESTIGATION of petroleum laws and regulations, company practices, and petroleum prices may be undertaken in U. S. Senate as result of pressure being applied by Senate Minority Floor Leader Wherry. Senate Small Business (Maybank) Subcommittee has been studying petroleum prices.

ALTHOUGH EXPORT demand for U. S. lubricating oils will hold about unchanged during next several years, domestic requirements will be under 1948 levels for a few years. Productive capacity meanwhile will be higher, leaving potential production above demand. Older, less efficient lube plants will be forced to curtail. Holding down domestic demand will be less oil use by newer motor vehicles, more durable lubes, and lower industrial activity and industrial lube use. These predictions were made by Paul Keyser, Jr., Socony-Vacuum Oil Company, before National Petroleum Association.

CALIFORNIA'S OIL INDUSTRY faces prospect of continuing over-production of crude and heavy fuel oil, and surpluses of lighter products also are showing up. Feeling is growing that state proration may be only means for handling over-production. Although second largest producing state, California has no petroleum conservation law, and crude production volume has been subject only to voluntary proration of producers rather than state allowables.

RECENT AND PROSPECTIVE increases in allowables in Texas and other states will stimulate well completions for latter part of year. Higher allowables of September and October for Texas brought prompt increases in drilling permit applications.

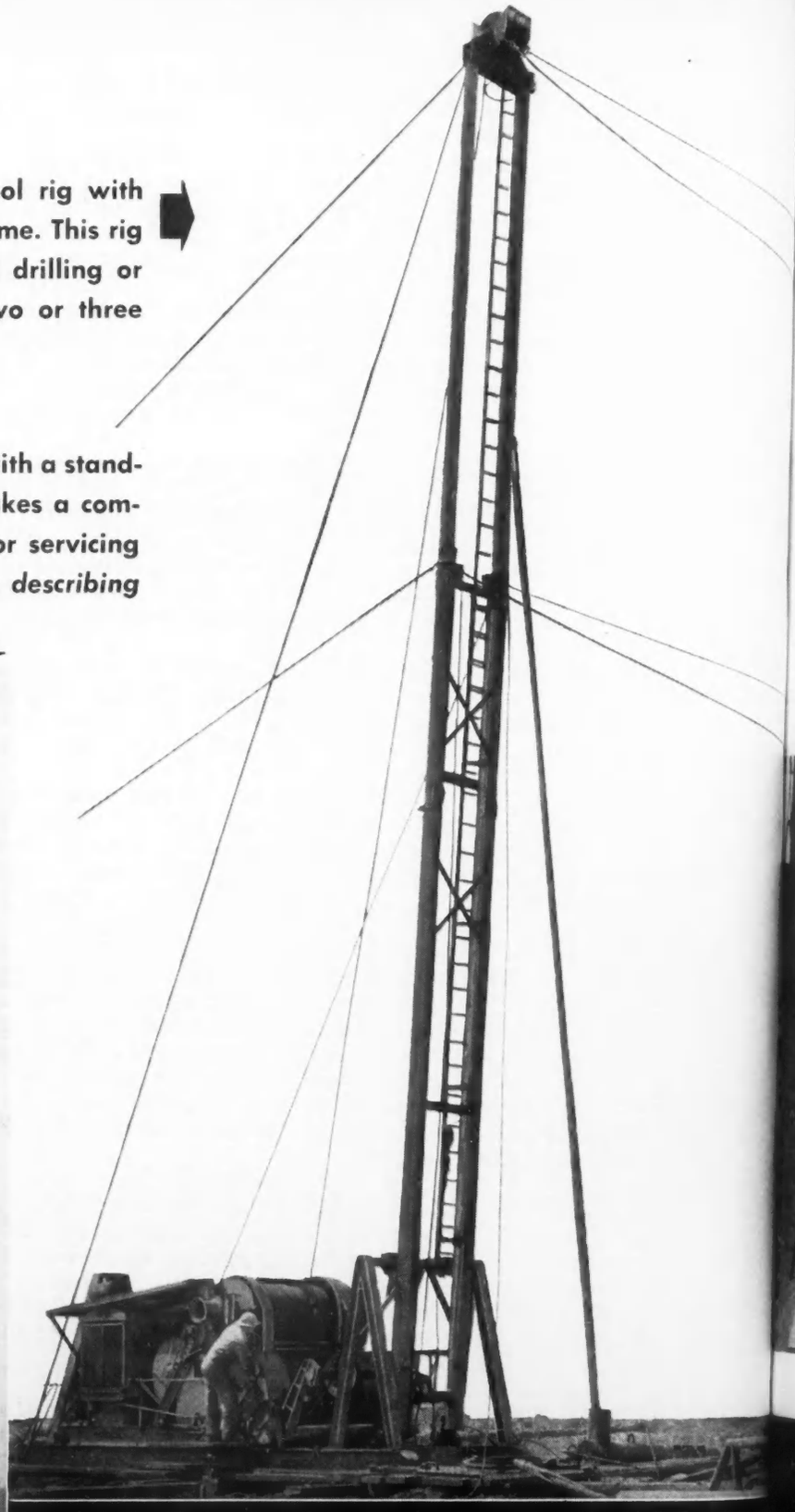


DAY IN

You Can Make More Money

A portable, fast-moving cable tool rig with 65-foot double leg mast on subframe. This rig can be moved in, rigged up and drilling or servicing operations started in two or three hours.

The new "Cardwell" Trailermast with a standard Model R draw works. This makes a completely unitized portable drilling or servicing outfit. *Write for our new catalog describing the "Cardwell" Trailermast.*

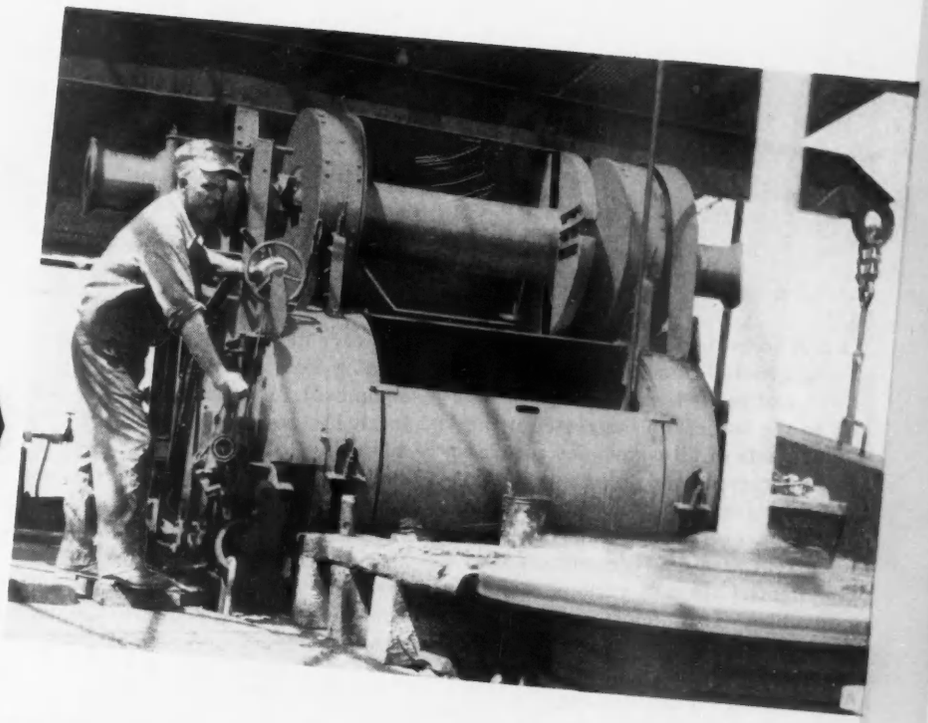


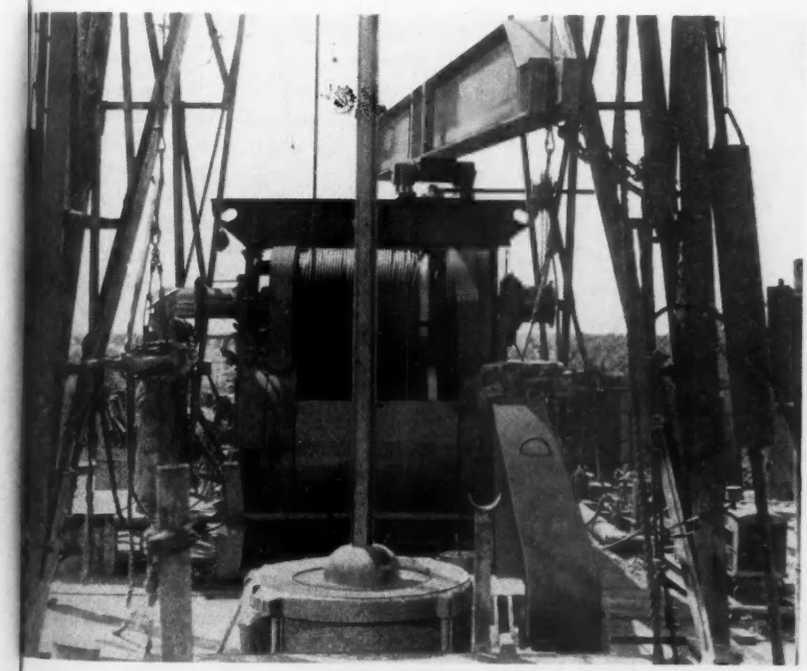
AND DAY OUT

with a "CARDWELL" Combination Rig . . .

The real profit advantage of this "Cardwell" rig is its versatility. You can keep this combination rig busy because it does every kind of drilling or servicing job with either rotary or cable tools. The same rig can be changed over in a few hours to either rotary table drive or spudding assembly.

Model R equipped as a double drum draw works. This is the same basic rig as the double spudder shown on the opposite page. The rotary rig can be changed over to cable tool operations to "tail in" for a better producing well in low pressure areas.





A Model R equipped with rotary drive and a beam assembly. Both assemblies are in place and ready for use in a few minutes. No change in equipment is necessary to switch from rotary to cable tools. The heavy-duty beam is ideal for cable tool drilling and pumping potentials. The complete rig can be easily transported on a truck or trailer.

Three sizes of "Cardwell" combination drilling rigs are available for cable tool drilling to 7,500 feet, and rotary drilling with 4½-inch pipe to 4,500 feet. *Send today for our new catalog.*

"Cardwell's" reputation in all fields for building "Tough Iron" comes from the use of Alloy steels and heat-treatment. This "know how" cannot be copied.

CARDWELL

REG. U. S. TRADE MARK PAT. OFFICE

THIS TRADE MARK INSURES HIGHEST QUALITY AT LOWEST PRICE

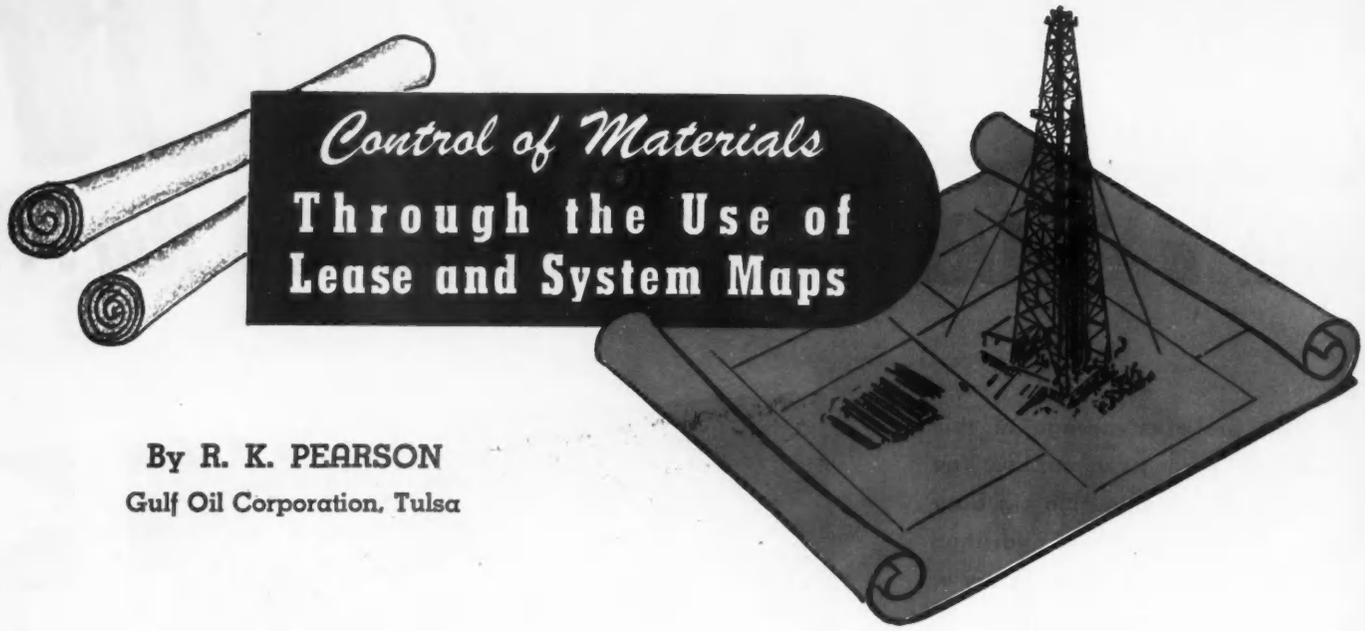
CARDWELL MFG. CO. INC.

P. O. Drawer 2001 . . . Long Distance Telephones 128—129—130

Cable Address: "ALL STEEL," Wichita — "CARDSTEEL," New York

Wichita, Kansas, U. S. A.

Control of Materials Through the Use of Lease and System Maps



By R. K. PEARSON
Gulf Oil Corporation, Tulsa

PROPERLY KEPT lease and system maps are an accurate and economical means of furnishing management full information for control and efficient use of materials. The maps provide currently a verification of fixed assets and a control of materials for their continued use or their reuse in other areas. The maps eliminate unnecessary purchase of items for replacement which can be obtained or salvaged from producing or temporarily abandoned properties or facilities, affording records to readily identify and locate those items.

The maps are valuable also for locating dead lines and surplus materials, for use in fields where personnel turnover is high, and when operations of a lease change from one operator to another.

As A foreword to this article the following generally accepted facts are repeated and recited for emphasis in relation to the subject to be treated upon.

The assets of all companies are classified into current and fixed assets. Management insists that a close scrutiny and control be exercised at all times over the current assets, which contain among other items Cash and various classes of Receivables. To support and to verify are reconciliation statements from banks and statements of certification describing and aging receivables, etc.

Fixed assets are also examined and verified for certain periods. These certifications being accomplished in part by the use of descriptive physical inventories. The mechanical or manual aspect of providing actual current physical inventory listings of lease, well and plant equipment, for installations on properties located throughout the world, has in many instances prohibited these certifications from being current. In some instances properties are never actually inventoried in physical detail more often than for five or ten year periods, due to the time consuming nature of such inventories and in addition the lack of qualified inventory crew personnel.

Replacement Problem

The oil industry is being confronted daily with the necessity of providing replacement materials for developed properties that are on the marginal line between profit and loss and abandonment. Many of these properties can be kept on economical production, for example, by reduction of fuel bills if size of power equipment was reduced and all surplus materials salvaged and sold or transferred to other similar properties at a use value, resulting in mutual benefits to both properties.

Therefore, it is the twofold purpose of this article to present procedures that will result in providing currently a verification of fixed assets and a control of those materials now in place for their continued purposeful use or reuse in other areas and thereby eliminate needless and costly calls upon the manufacturer for items for replacement which could well be obtained or salvaged from present producing or temporarily abandoned properties or facilities if proper records were maintained to readily identify and locate same.

It is believed that the foregoing information may be furnished to management more accurately and with the least cost from properly kept lease and system maps. These maps, in order to reflect physically and summarized totals of materials on hand, should provide the following information:

1. Tubular goods 2" and over
2. Derricks and masts
3. Tanks, Separators and Treaters
4. Buildings
5. Pumps (Not sub-surface)
6. Power units
7. Registered or serial numbered controlled items such as meters, etc.
8. Fabricated and shop made installations such as flow line manifolds
9. Cattle guards
10. Pipe fences

It would be possible to maintain maps reflecting these material items that would also contain in addition detailed information pertinent to the terrain, altitude above sea level, roads, canals, rivers and also other companies' lines crossing the lease. In brief this type of map would provide a geographic and material installation picture of the subject lease which would take hours or days to obtain either from a physical visit or search of historical files. This type of map is generally "to scale" and is prepared by a technical engineer sometime after the property has been developed and could easily result in considerable expense and may not be always currently up to date because of the expense involved in keeping it up to date.

The map controls herein proposed are those developed as the property is developed and are made possible by the efforts of the regular field operating personnel and drafting or mapping departments of the general office. Such maps are for the sole purpose of controlling materials, and for use in taking physical

You don't lead in sales for 17 years unless you lead in value!

International Trucks have led in heavy-duty truck sales for 17 straight years!

WHAT HEAVY-DUTY TRUCKS offer the biggest value? The most exacting truck buyers in America have answered that one.

You can find their answer by looking at registration figures for new trucks with gross weight ratings of 16,001 pounds or over.

Those figures show that International Trucks have been *America's largest-selling heavy-duty trucks for 17 straight years!*

A heavy-duty truck is a major investment. You can bet your bottom dollar that the men who buy them don't give any line of trucks a vote of confidence like they've given International unless their profit and loss statements show them that it pays.

But don't think that International Trucks offer outstanding value in the heavy-duty field *alone*. There are 22 models of International Trucks plus 1000 specialized variations to meet individual hauling requirements. Gross weight ratings range from 4,400 to 90,000 pounds.

Trucks built to meet your specifications—No matter what model International Truck you buy, you get the basic values that have made International Trucks the largest-selling heavy-duty trucks in America for the past 17 years.

You get a rugged truck unweakened by a single compromise with passenger car design.

You get a long-lasting truck. *More than half of all the Internationals built in the last 42 years are still on the job.*

You get a truck specialized to meet your particular specifications; specified by a truck sales engineer who knows your business in terms of the demands it makes on trucks.

See your International Truck dealer or branch.

International Harvester Builds
McCormick Farm Equipment and Farmall Tractors
Motor Trucks and Industrial Power
Refrigerators and Freezers

Tune in James Melton and "Harvest of Stars"
NBC, Sunday afternoons

INTERNATIONAL TRUCKS

INTERNATIONAL HARVESTER COMPANY • CHICAGO

FIRST IN HEAVY-DUTY TRUCK SALES FOR 17 STRAIGHT YEARS

inventories and to provide other related incidental information.

The mechanics for the preparation of the map are few and are as follows:

The original source record is the Property Inventory Plat (Figure 1). It needs to be no larger than 8½ x 11 inches in size. This form or one similar is to be prepared immediately upon the completion of an installation or material change made to a property. It is to be made by the foreman in charge of the property or by a clerk under his supervision and direction. The information or data reflected thereon must be absolutely correct. The sketch of the installation or change does not necessarily have to be to scale but the directions, descriptions and footages must be accurate. Abbreviations are used wherever possible such as O for oil, G for gas, V for vent and R for riser. Note the following important features reflected in Figure 1:

1. Name of lease
2. Lease location
3. Location well No. 1
4. Location of Tank Battery in relation to well No. 1
5. Summary of Equipment in agreement with material shown in sketch
6. Date work performed
7. Inventory plat number

It will be noted this plat has been given the number 1-1 for convenience in this illustration. The first digit represents the District, Area or Zone in which the property is located. The second digit represents the numerical sequence number for the plats as they are prepared. Any other system of numbering may be employed.

The completed plat is passed to the mapping department where it is turned over to a draftsman who, since no map or record for this property is on file, obtains a number for a new map and proceeds from the information on the plat to prepare a map from which copies may be reproduced by a blue print machine. Subsequent plats will be drawn to this map and plats placed on permanent file for reference to support all changes or additions to the map. Blue prints are recommended instead of black and white prints or photostats or other types of maps because it has been found blue prints do not fade as rapidly as other kinds and also do not crack under constant handling.

PROPERTY INVENTORY PLAT

DATE April 20, 19 45

Blank Oil Company
NAME OF COMPANY

LEASE, PLANT OR SYSTEM NAME J. D. Smith Lease — A.F.E. OR OTHER CHARGE 4321 — INVENTORY MAP NO. [illegible]

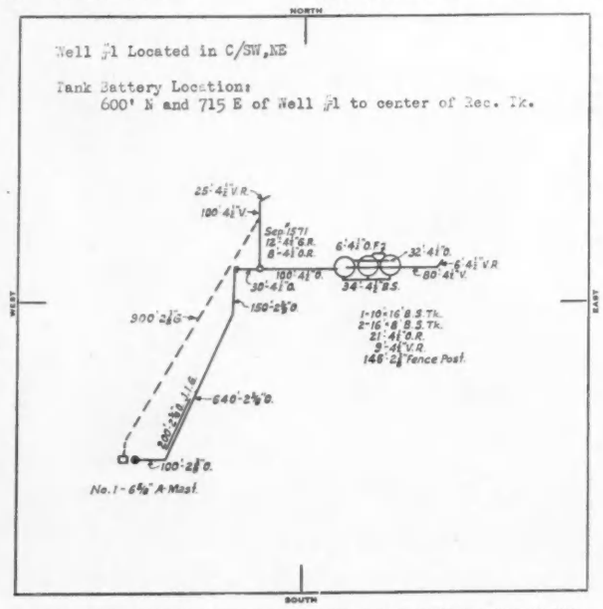
SEC. 7 TWP. 3S RANGE 4E

DESCRIPTION OF WORK Drill & Complete #1-Equip to Pump-Install Tank Battery

CHANGE LEASE INVENTORY MAP AND ACCOUNTING DEPARTMENT INVENTORY TO AGREE WITH DISTRICT OFFICE RECORDS AS FOLLOWS:

Pipe & Equipment	INSTALLED	REMOVED	B. P., SERIAL OR REG. NO.	ON LEASE LAST INV.	ON LEASE THIS INV.
2 3/8" OD Line Pipe	1740'			0	1740'
4 1/2" OD Line Pipe	463'			0	463'
2 3/8" OD Line Pipe - J.I.G. (Junked in Ground)	200'			0	200'
2 3/8" OD Fence Posts	146'			0	146'
3' x 11' H&W OAG Separator	1		Ser.#2102 Reg#1571	0	1
OCS 56 Type 5-D-3 Polly Pumping Unit	1		23157	0	1
10'x16' Bolted Steel Tank	1			0	1
16'x8' Bolted Steel Tank	2			0	2
ZC-208 F&W G.E.	1	Ser. #2051	Reg.#1734	0	1

DATE WORK PERFORMED March 1 to April 15 — PREPARED BY J. A. Brown



LINES OR EQUIPMENT LIFTED SHOWN IN BLACK CROSSED OUT IN RED.

REMARKS 200' 2 3/8" L.P. J.I.G. Temporary Service Lines Not Recovered From D&C
Send 2 Copies of Completed Map To District #1 Office.

CORRECT A. J. Smith
DISTRICT CLERK

INVENTORY PLAT NO. 1-1

FIGURE 1

Completed Map

Figure 2 (see page 42) illustrates a completed map of the property five years after it was started in Figure 1. This map should not be smaller than 18 x 24 inches in size. Note these pertinent features:

1. Location and description of all wells and installations
2. Summary of all major controllable materials
3. Indicates 270 feet of 2⅜-inch Line Pipe dead and subject to recovery
4. Well No. 3 temporarily abandoned with the possibility of 310 feet of 8⅝-inch and 3140 feet of 5½-inch casing to be recovered
5. Also 200 feet of 2⅜-inch line pipe junked in ground subject to recovery or sale in place
6. Date of last physical inventory
7. Record of recent inventory plat corrections and date map corrected and summary verified or checked.

This completed map contains all major controllable materials. Additional items such as valves and well head connections, etc., may be shown and controlled if desired.

For physical inventory purposes the map is to be used and items and footages checked instead of listing of each item at time of inventory. In addition to eliminating the manual listing at time of inventory, its use will also speed up the inventory by readily locating all items to be inventoried and giving footages that have been determined at time line was laid. To verify these footages, spot measurements are to be made only when deemed necessary. If listings are required, take off may be prepared by clerks per notations made on map by inventory man.

This paper has been prepared to bring out the use of maps to facilitate the control of materials and for this use only they are believed to justify to management their cost of preparation and maintenance. But before closing, it is necessary to mention other uses where they would be invaluable, such as locating dead lines and surplus materials, their use in fields where personnel turnover is highest and also when the operations of a lease might change from one operator to another.

PETRO-TECH

makes these Lane-Wells Services and Products available throughout Venezuela.

KONESHOT AND BULLET PERFORATING

Every new development in perforating equipment and operating technique available in Venezuela with its introduction in the United States. Same Lane-Wells system of rigid inspection and tolerances.

PACKERS

A large selection of packers and packer parts in stock at all Petro-Tech branches.

DRILLABLE BRIDGING PLUGS

for popular casing sizes and weights are available at all Petro-Tech branches.

PETRO-TECH SERVICE CO.

3er PISO, EDIFICIO REPUBLICA, PUENTE REPUBLICA
CARACAS, D. F., VENEZUELA

MARACAIBO · LAS MOROCHAS · EL TIGRE · ANACO · JUSEPIN · LAS MERCEDES

inventories and to provide other related incidental information.

The mechanics for the preparation of the map are few and are as follows:

The original source record is the Property Inventory Plat (Figure 1). It needs to be no larger than 8½ x 11 inches in size. This form or one similar is to be prepared immediately upon the completion of an installation or material change made to a property. It is to be made by the foreman in charge of the property or by a clerk under his supervision and direction. The information or data reflected thereon must be absolutely correct. The sketch of the installation or change does not necessarily have to be to scale but the directions, descriptions and footages must be accurate. Abbreviations are used wherever possible such as O for oil, G for gas, V for vent and R for riser. Note the following important features reflected in Figure 1:

1. Name of lease
2. Lease location
3. Location well No. 1
4. Location of Tank Battery in relation to well No. 1
5. Summary of Equipment in agreement with material shown in sketch
6. Date work performed
7. Inventory plat number

It will be noted this plat has been given the number 1-1 for convenience in this illustration. The first digit represents the District, Area or Zone in which the property is located. The second digit represents the numerical sequence number for the plats as they are prepared. Any other system of numbering may be employed.

The completed plat is passed to the mapping department where it is turned over to a draftsman who, since no map or record for this property is on file, obtains a number for a new map and proceeds from the information on the plat to prepare a map from which copies may be reproduced by a blue print machine. Subsequent plats will be drawn to this map and plats placed on permanent file for reference to support all changes or additions to the map. Blue prints are recommended instead of black and white prints or photostats or other types of maps because it has been found blue prints do not fade as rapidly as other kinds and also do not crack under constant handling.

PROPERTY INVENTORY PLAT

DATE April 20, 19 45

Blank Oil Company
NAME OF COMPANY

LEASE, PLANT OR SYSTEM NAME J. D. Smith Lease — A.F.E. OR OTHER CHARGE 4321 — INVENTORY MAP NO. [illegible]

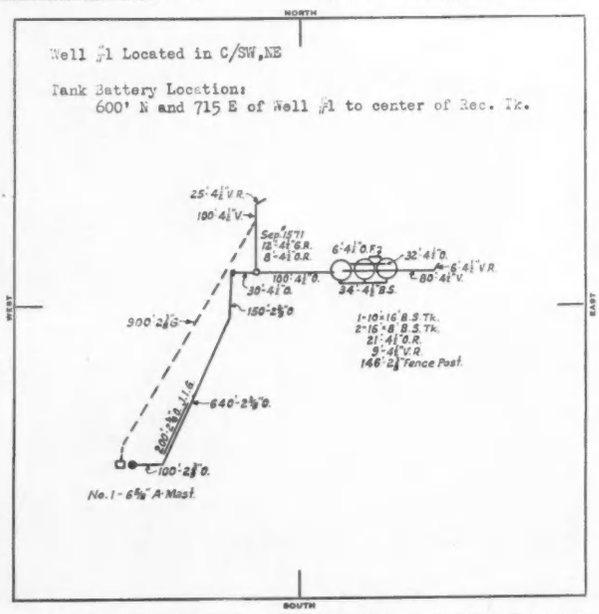
SEC. 7 TWP. 3S RANGE 4E

DESCRIPTION OF WORK Drill & Complete #1-Equip to Pump-Install Tank Battery

CHANGE LEASE INVENTORY MAP AND ACCOUNTING DEPARTMENT INVENTORY TO AGREE WITH DISTRICT OFFICE RECORDS AS FOLLOWS:

Pipe & Equipment	INSTALLED	REMOVED	B. P. SERIAL OR REG. NO.	ON LEASE LAST INV.	ON LEASE THIS INV.
2 3/8" OD Line Pipe	1740'			0	1740'
4 1/2" OD Line Pipe	463'			0	463'
2 3/8" OD Line Pipe - J.I.G. (Junked in Ground)	200'			0	200'
2 3/8" OD Fence Posts	146'			0	146'
3' x 11' H&W O&G Separator	1	Ser.#2102	Reg#1571	0	1
OCS #5 Type 5-D-3 Polly Pumping Unit	1		23157	0	1
10'x16' Bolted Steel Tank	1			0	1
16'x8' Bolted Steel Tank	2			0	2
ZC-208 F&N G.E.	1	Ser.#20511	Reg.#1734	0	1

DATE WORK PERFORMED March 1 to April 15 — PREPARED BY J. A. Brown



LINES OR EQUIPMENT LIFTED SHOWN IN BLACK CROSSED OUT IN RED.

REMARKS 200' 2 3/8" L.P. J.I.G. Temporary Service Lines Not Recovered From D&C
Send 2 Copies of Completed Lap To District #1 Office.

CORRECT A. J. Smith (DISTRICT CLERK) — INVENTORY PLAT NO. 1-1

FIGURE 1

Completed Map

Figure 2 (see page 42) illustrates a completed map of the property five years after it was started in Figure 1. This map should not be smaller than 18 x 24 inches in size. Note these pertinent features:

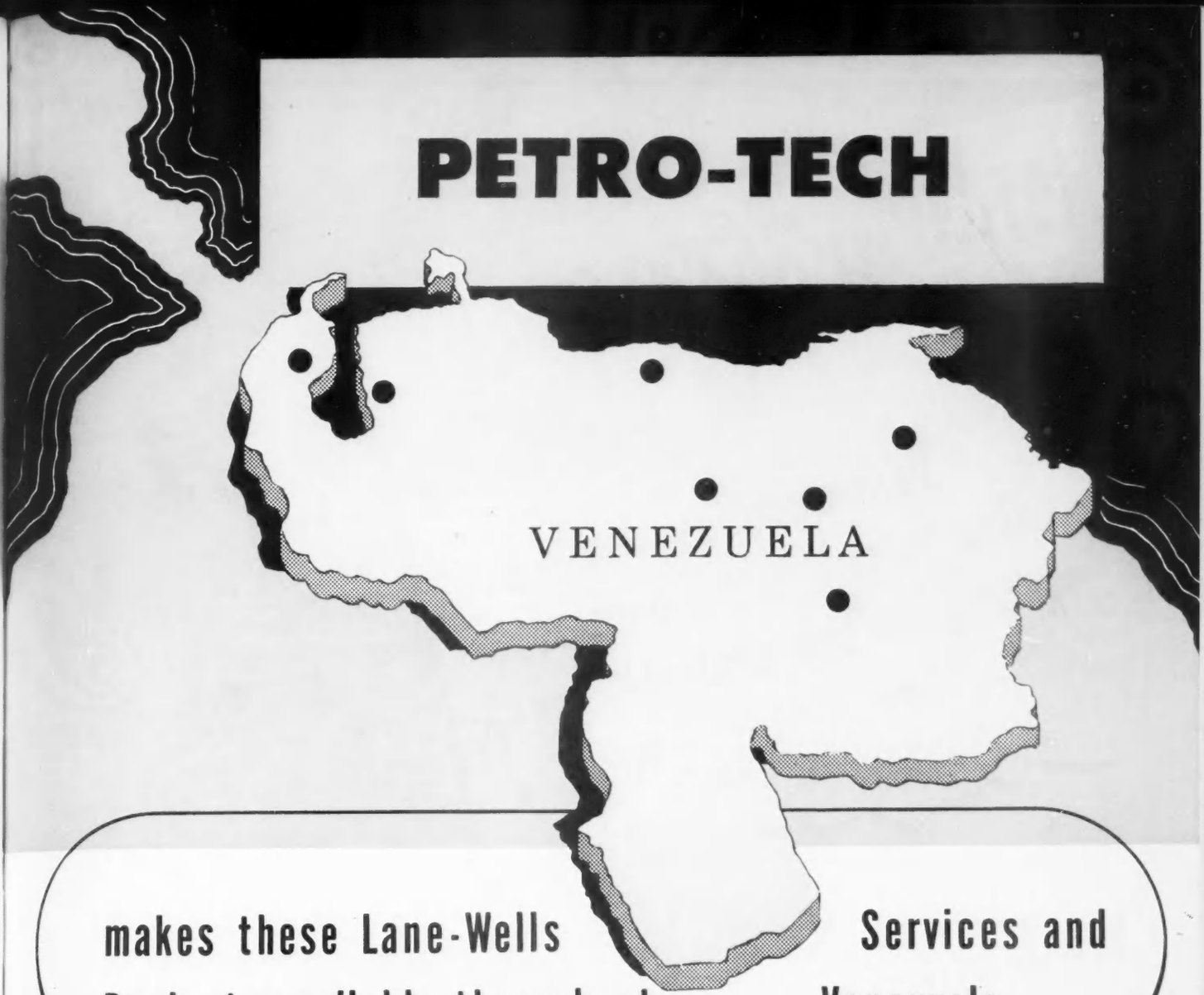
1. Location and description of all wells and installations
2. Summary of all major controllable materials
3. Indicates 270 feet of 2⅜-inch Line Pipe dead and subject to recovery
4. Well No. 3 temporarily abandoned with the possibility of 310 feet of 8⅝-inch and 3140 feet of 5½-inch casing to be recovered
5. Also 200 feet of 2⅜-inch line pipe junked in ground subject to recovery or sale in place
6. Date of last physical inventory
7. Record of recent inventory plat corrections and date map corrected and summary verified or checked.

This completed map contains all major controllable materials. Additional items such as valves and well head connections, etc., may be shown and controlled if desired.

For physical inventory purposes the map is to be used and items and footages checked instead of listing of each item at time of inventory. In addition to eliminating the manual listing at time of inventory, its use will also speed up the inventory by readily locating all items to be inventoried and giving footages that have been determined at time line was laid. To verify these footages, spot measurements are to be made only when deemed necessary. If listings are required, take off may be prepared by clerks per notations made on map by inventory man.

This paper has been prepared to bring out the use of maps to facilitate the control of materials and for this use only they are believed to justify to management their cost of preparation and maintenance. But before closing, it is necessary to mention other uses where they would be invaluable, such as locating dead lines and surplus materials, their use in fields where personnel turnover is highest and also when the operations of a lease might change from one operator to another.

PETRO-TECH



makes these Lane-Wells Services and Products available throughout Venezuela.

KONESHOT AND BULLET PERFORATING

Every new development in perforating equipment and operating technique available in Venezuela with its introduction in the United States. Same Lane-Wells system of rigid inspection and tolerances.

PACKERS

A large selection of packers and packer parts in stock at all Petro-Tech branches.

DRILLABLE BRIDGING PLUGS

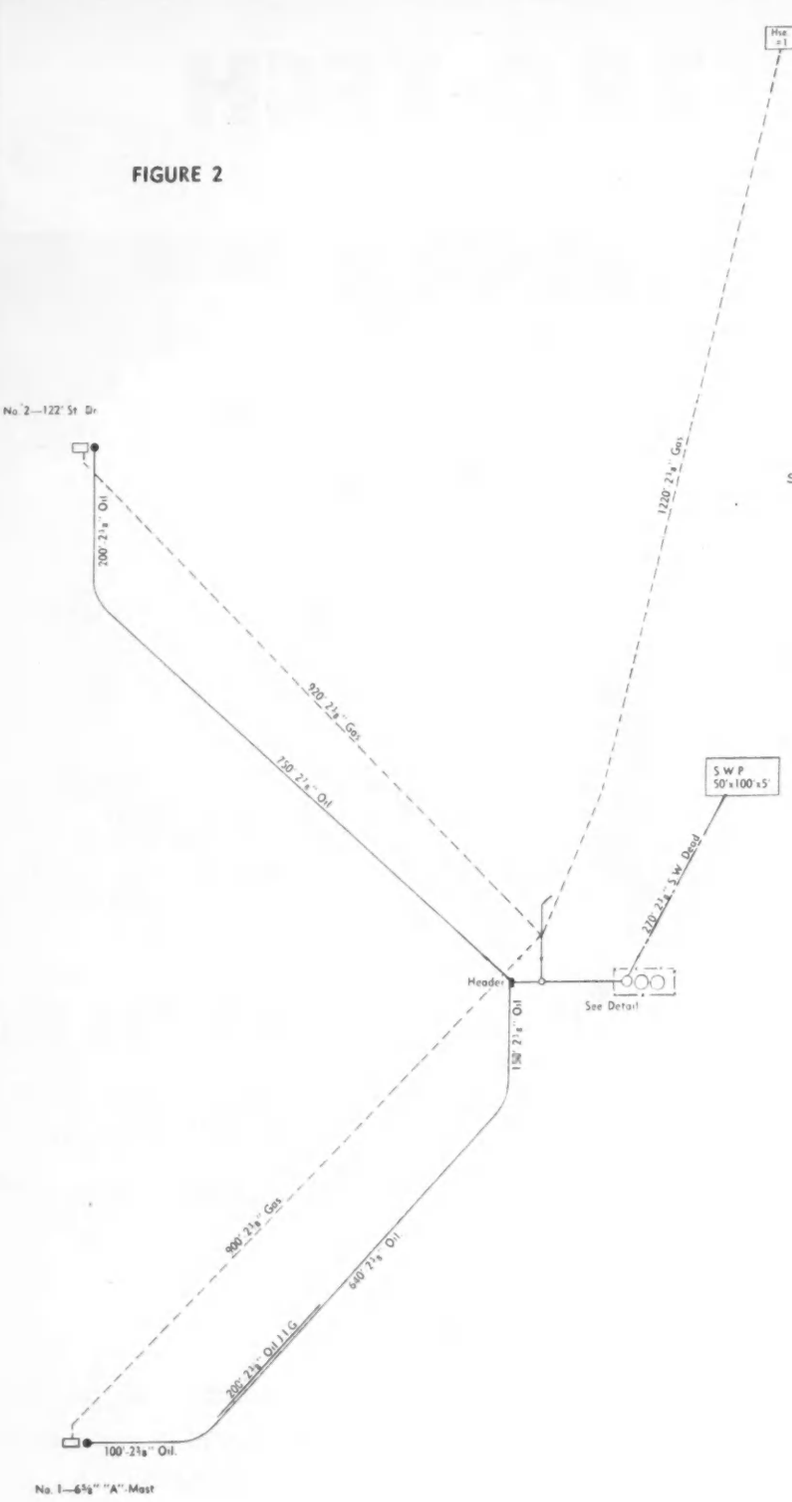
for popular casing sizes and weights are available at all Petro-Tech branches.

PETRO-TECH SERVICE CO.

3er PISO, EDIFICIO REPUBLICA, PUENTE REPUBLICA
CARACAS, D. F., VENEZUELA

MARACAIBO · LAS MOROCHAS · EL TIGRE · ANACO · JUSEPIN · LAS MERCEDES

FIGURE 2



No. 3—T A

SUMMARY MAJOR CONTROLLABLE MATERIALS

LINE PIPE

2⅞"		4,400'
2½"		750
4½"		463
2⅞"	FENCE POSTS	146'
	JUNKED IN GROUND	
2⅛"		200'

TANKS

1	10'x16' 1200 BBL B.L.T.D.	STEEL
2	16'x8' I.L. 250 " "	"

BUILDINGS

HSE	1-20'x34'x8'	WOOD
GAR	18'x22'x8'	G.C.I.

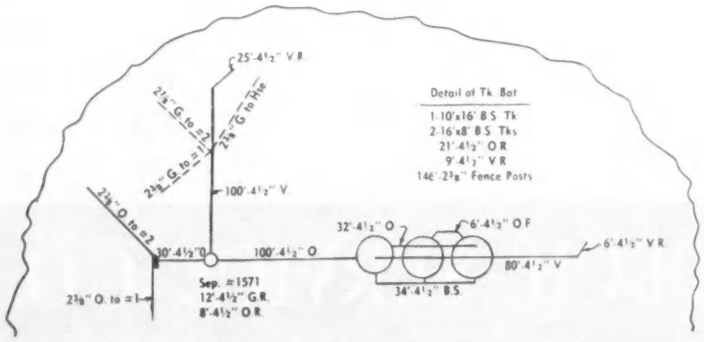
OTHER MATERIAL

TANK BAT.—3'x11' H&W O&G SEP. COMP. W/ 4" OIL & GAS VALVES SER. 3102 REG. 1571

WELL NO. 1-ZC-208 F&M G.E. SER. 90541 REG. 1734
OCS 5 TYPE 5-D-3 POLLY UNIT 23157
6¾"x42' A-MAST
8¼" CASING 340'
5½" CASING 3120'
2⅞" TUBING 3100'

WELL NO. 2-ZC-208 F & M G.E. SER. 87352 REG. 1941
OCS 5 TYPE 5-D-3 POLLY UNIT 1478
122' P.R.S.B.G. STEEL DERRICK
8⅝" CASING 280'
5½" CASING 3212'
2⅞" TUBING 3150'

WELL NO. 3-8¼" CASING 310'
5½" CASING 3140'



TUBING BREAK THREATENS 6800-FT. WELL!

But delayed, postponed, retarded set of Unaflo* saves valuable time and equipment

(Well location and names withheld by request)

DEPTH OF SQUEEZE . . . 6780 to 6800 feet.
BOTTOM HOLE PRESSURE . . . approximately 1900 P.S.I.
TEMPERATURE . . . 150°F. — MAXIMUM PRESSURE . . . 3800 P.S.I.
TIME CONSUMED . . . 2 hours, 45 minutes.

Sixty sacks of Unaflo* Oil-Well cement were mixed, with a slurry weight of 16 lbs. The pressure went up to 3800 p.s.i. and then broke back to 3000 p.s.i. A half-barrel was squeezed. Pressure broke back to zero. Operators picked up one joint, closed the rams and reversed circulation. A half-barrel of fluid cement was recovered.

Then, operators started out the hole with the tubing. The break was found 1850′ off the bottom of the tubing. At this critical point, it was found that the Unaflo cement was still fluid and pumpable after 2 hours and 45 minutes. It fell out of the tubing, as each stand was landed. 1850 feet of tubing were saved. The well was returned quickly to operation. The tool pusher remarked that he could always rely on Unaflo even under the toughest conditions.

Unaflo cement, with its delayed, postponed, *retarded* set, does not stiffen prematurely. It remains fluid and pumpable throughout the entire cementing operation. And, as shown above, its retarded set allows ample time in emergencies to correct the cause of trouble. After retardation, it hardens normally to form an impervious seal.

Send for this helpful free bulletin

It gives you, in handy reference form, the many advantages of Unaflo. Practical case histories back up technical information with actual oil-well applications. Easy-to-follow diagrams illustrate the sections dealing with various cementing operations. Get your copy of "UNAFLO Oil-Well Cement." Write today to Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.

**"UNAFLO" is the registered trade mark of the retarded oil-well cement manufactured by Universal Atlas Cement Company*

WACO • KANSAS CITY • BIRMINGHAM • CHICAGO • NEW YORK

Export Distributor:
United States Steel Export Co., New York

WO-U-109

UNIVERSAL ATLAS CEMENT COMPANY

OIL-FIELD CEMENTS

Unaflo *Retarded* Oil-Well Cement
Resistant to Sulfate Waters
Atlas Portland Cement—Type I

Atlas Portland Cement—Type II
Resistant to Sulfate Waters
Atlas High-Early Cement—Type III

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

A Nickel for a Friend

Shell's Motion Picture Program

By AL REESE, Managing Editor

A NICKEL for a friend.

That's the bargain price Shell Oil Company is paying through motion pictures to gain good will for the oil industry.

Shell's 1949 motion picture program is budgeted at $250,000. With more than 5 million persons certain to see the films this year, the per capita cost to the company will be less than 5 cents.

The firm's elaborate film program was inspired by the knowledge that (1) the oil industry must have better public understanding; and (2) that films offer an ideal medium for winning that understanding.

A recent survey convinced Shell officials that those who know least about the oil industry have the worst opinions of it. Conversely, they concluded, "Those who know you well, think well of you."

To acquaint the public with the industry, Shell and other companies have turned their public relations programs to all accepted channels of communication—the press, radio, and motion pictures. That films carry a heavy share of the load is attested by the fact that Shell's pictures were seen in 1948 by 4,657,349 persons at 41,137 showings. Seven television showings raised the year's total by another 251,000. In the first three months of 1949, the films were shown 16,584 times to a total audience of 1,437,174, which is much above the 1948 period. Television audiences totaling 2,042,000 saw 44 showings of the films in the first three months of this year.

Shell's long-time picture-making program gained impetus during World War II when it was noted that troops in training learned faster and retained more from motion pictures than any other educational technique. Motion pictures appeal to both the eye and ear, whereas most other mediums command the attention of only one or the other. Film subjects are presented vividly, quickly, entertainingly. A motion picture in a darkened, quiet room invites greater concentration than perhaps any other educational medium.

ENTERTAINING ENLIGHTENMENT of the public concerning the oil industry is the goal of Shell Oil Company's motion picture program. The program is budgeted at $250,000 for 1949—a bargain price considering that the films will be seen by more than 5 million persons.

Ideas from Employes

Shell's films originate with ideas from employes. The best suggestions filter up to a policy-making committee drawn from top management. When the group approves a film suggestion, it assigns the job to the department that originated the idea, or, more often, to the Public Relations department.

Several motion picture producers are invited to make bids and those offering the most attractive bids are paid a flat fee to prepare a story board, which is a detailed presentation of the film, done with drawings and script. The best story board wins the contract for the finished film.

When the first print of the picture is completed, it goes back to the committee for changes. Then the necessary reshooting is done and the final print is duplicated in quantity for distribution.

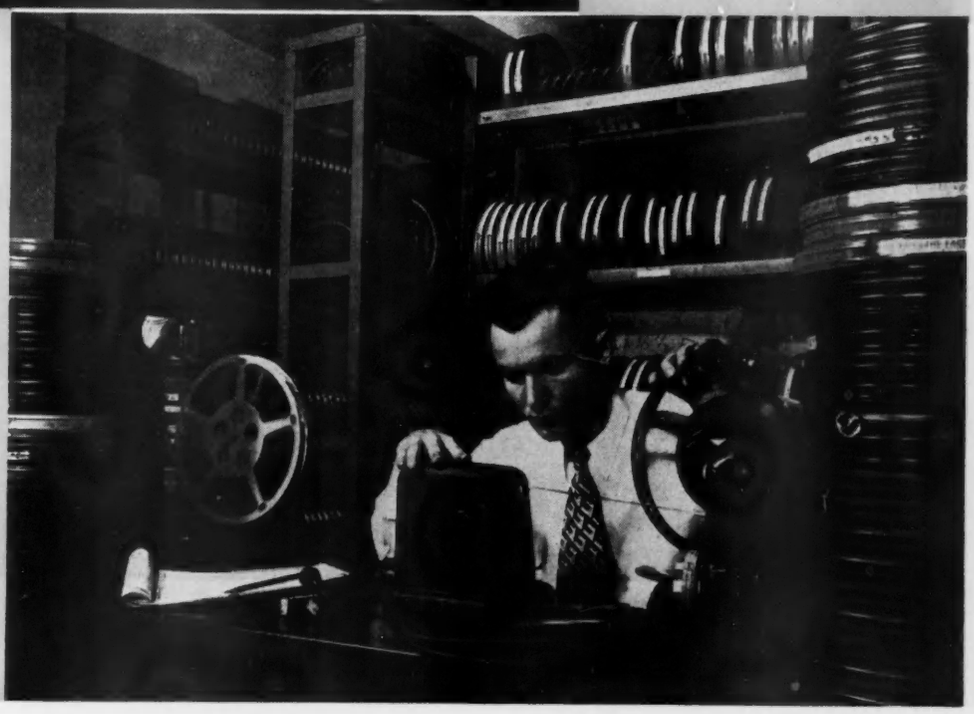
The painstaking craftsmanship that goes into the films was illustrated in the making of "Prospecting for Petroleum," the story of oil exploration. Utilizing Hollywood's newest animation technique, the picture was in production almost six months. It runs about 23 minutes and has 33,120 frames, each of which had to be shot at least three times to meet Technicolor requirements. As many as 20 technicians and four cameras were required to film some scenes.

To create its dramatic action, technicians built a miniature wooden figure for each character, used these over and over again with different heads, arms and legs to depict various movements, and photographed each pose with a stop motion camera. Not only was it necessary to duplicate the complexities of the human figure in miniature models from two inches to a foot high, but the miniatures had to be historically accurate. The model of George Bissell, for instance, was made from an old tintype found in an early history of the oil industry. It is authentic to the very buttons on his frock coat and the length of his sideburns.

Along with the technical skill that goes into the films is one other priceless ingredient for entertaining enlightenment. It was not alone the desire to learn more about the oil industry or to view sprightly and colorful miniatures on the screen that attracted nearly 5 million persons last year. The other ingredient in the recipe for winning friends through films is sparkling dramatization. A public that might be indifferent to a bald recounting of the money, toil and time that have been spent in the search for oil is entertained and impressed by these same facts as presented in the film, "Prospecting for Petroleum." Depicting the industry as big, colorful, vital, it traces mankind's interest in petroleum deposits from the days of ancient Babylon to the bringing in of the first com-

RIGHT: Cameramen prepare to shoot a medicine show scene in the Shell film, "Prospecting for Petroleum," which tells how oil was formed and dramatizes man's search for it down through the ages. Filmed in Technicolor, "Prospecting for Petroleum" makes use of Hollywood producer George Pal's unusual animation technique, showing scientific aspects of oil exploration hitherto difficult to picture.

LEFT: Keeping track of the hundreds of prints which pass in and out of the film libraries every week is no easy job. To do it, bookings are recorded in a Kardex file system and the whereabouts of each film is always known. Here a film technician at one of Shell's four libraries is checking the file to see what film will be available for showings on a certain date.



RIGHT: A technician in one of Shell's libraries inspects a film, checking for breaks and sound before cleaning and returning it to the racks, ready for the next showing. Any responsible group equipped with a 16 millimeter sound projector is eligible to borrow a film.

mercial oil well in 1859. From this point, through its lively three-dimensional miniatures, its color and music, the film takes up the science of oil exploration, showing how it advanced from the days of playing hunches to the employment of amazing devices for "seeing into the ground."

At no time does the film stray from Shell's purpose of giving an authentic and understandable account of the petroleum industry at work, but nowhere does it resort to stuffing tasteless facts down the audiences' throats. Every morsel of information is sugar-coated with romance and drama.

Once completed, the films must be "sold" to the public, which is no small task because of the limited mediums for promotion.

Perhaps the most successful piece in building Shell's film audience is the catalog, which is sent free to anyone inquiring about the program. The catalog begins with an invitation to borrow the films, then describes each picture with pungent brevity and accompanying color illustrations, and winds up with a motion picture request form, complete with directions for ordering films.

Not content with winning friends among the adult public, Shell's promotion takes dead aim at the future generation. Schools are encouraged to borrow the films, and to make sure that the youngsters retain what they learn of the oil industry, a teacher's manual has been prepared on the newer films for classroom use.

So thorough is the manual that teachers of science, history and social studies, English, geography and art may all find in it test questions and suggestions for essays on the oil industry and the film just viewed by students.

For classroom use there is also a four-color wall chart on the newer films and booklets describing techniques used in making the films.

For audiences beyond the classroom, Shell has prepared "stuffers" for direct mail promotion among thought leaders throughout the country.

Four Film Libraries

To distribute the films, Shell has set up libraries in San Francisco, Houston, Chicago and New York, each serving a designated segment of the U. S. Each library has from ten to 100 prints of each film, as well as a Kardex filing system, by means of which librarians can tell at a glance whether a print is in the office or on loan, and when it is to be shipped out or due to return to the library.

After each showing the films are inspected and, if necessary, repaired. After every fifth showing, each film is cleaned and checked for sound.

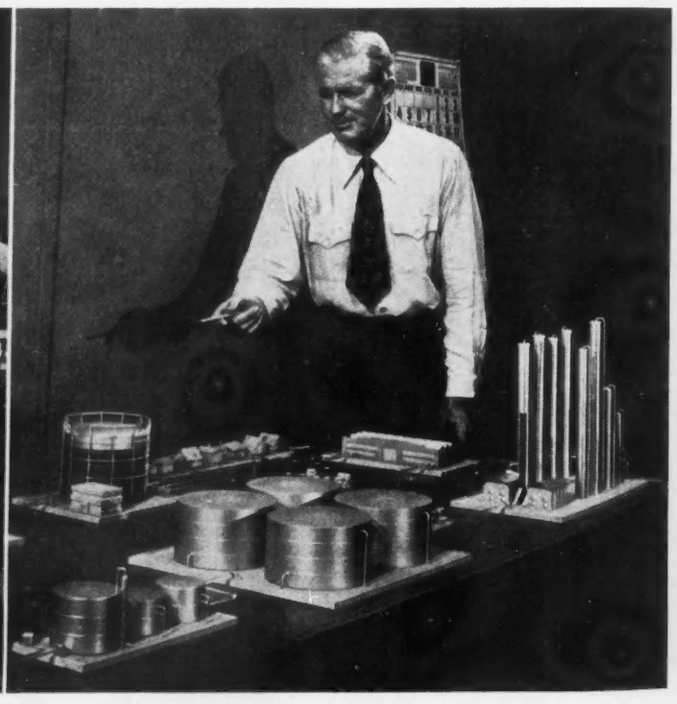
Any responsible, organized group equipped with a 16 millimeter sound projector is eligible to borrow a film on condition the return postage is paid and that, after the showing, an attendance card is filled out and enclosed.

Occasionally, if a film is requested by a group near one of the film libraries, Shell provides not only the film but also a projectionist. In such cases, Shell is apt to send a speaker who talks briefly about the film being shown and about the motion picture program in general.

Some prints are placed on permanent loans with such organizations as visual aid and film libraries, visual education departments of large school systems, universities, and state departments of public safety.

On such loan are more than 30 prints of "Screw Drivers and Screw Jays," made to combat the bad traffic manners which cause accidents and endorsed by The National Safety Council the International Association of Chiefs of Police, and other safety groups. This film ranked first in popularity among Shell's pictures last year, followed by "Prospecting for Petroleum," first in the "This Is Oil" series, most recent and outstanding films in Shell's collection. Two others in the series—"Birth of an Oil Field" and "Refining for Energy"—have been produced, and three others covering transportation, research and marketing will complete a full presentation of oil industry operations from field to customer. This series, plus other public relations films, are all suited for educational, church, civic and industrial groups.

For employes, Shell has a number of training films on such subjects as dealer procedure and safety.



LEFT: Scene from "Prospecting for Petroleum."

RIGHT: A geologist explains the route oil takes after it leaves the well in this still from Shell's "Birth of an Oil Field."

THE ERWIN-NEWMAN COMPANY ESTABLISHES A RECORD BUILDING PERFORMANCE 25 MILES AT SEA!

Magnolia Petroleum Company's Eugene Island No. 51 off-shore drilling foundation built in record time at record saving.

In these days of spirited competition, speed and efficiency are imperative for profitable and successful operation. The Erwin-Newman Company cognizant of these factors proved their already known ability by completing Magnolia Petroleum Company's Eugene Island No. 51 off-shore drilling foundation in record time and at a tremendous saving to the client.

The Erwin-Newman Company with its experienced engineers and efficient off-shore construction equipment will design, fabricate, and erect foundations for you or build according to your design and specifications. If you are planning off-shore drilling foundations, call the Erwin-Newman Company. One of their experts will gladly discuss your problems with you. His experience and proved ability may save you time and money.

THE ERWIN-NEWMAN COMPANY

P. O. Box 1308 HOUSTON 1, TEXAS LI nden 8186

Unitization Desirable

In Secondary Recovery

By W. A. HEATH
Earlougher Engineering Company, Tulsa

UNITIZED operation of oil fields is synonymous with conservation of oil. Future national safety depends in large part on the adequacy of crude reserves and ability to reduce them to possession when emergency arises. Much more consideration, therefore, should be given to measures of conservation and establishment of practices which will insure the maximum recovery of oil from reservoirs. Heading the list of such practices are secondary recovery and unitized development and operation.

Undoubtedly, there are many oil pools in the U. S. with secondary recovery possibilities which will be abandoned without application of secondary methods because of diversified ownership and unwillingness of any one operator to take the sole risk of the capital expenditure required to prove or disprove the feasibility of such methods.

About 20 years ago the organization of drilling units for spreading the cost of exploration of wildcat acreage was instigated and has enjoyed increasing usage until today it has become an accepted practice and has been a very important contributing factor in the development of the nation's oil reserves. The operators of leases in pressure-depleted fields could well consider application of secondary methods in the same light and pool their interests for a joint test of secondary possibilities, thus sharing the risk and benefits attendant upon such a venture.

UNITIZATION OF leases for the purpose of applying secondary recovery methods has become a prevalent practice in various areas and is recommended for other districts. There are many oil pools in the U. S. with secondary recovery possibilities which will be abandoned without application of secondary methods because of diversified ownership and unwillingness of any one operator to take the sole risk of capital necessary to determine feasibility of such methods. Operators in such pressure-depleted fields should pool their interests for joint test of secondary possibilities, thus sharing the risk and benefits of such venture.

Early Operations

In certain areas, unitization of leases for the purpose of applying secondary methods has become prevalent. It is notable that one of the first major unitized operations in the U. S. was effected for the sole purpose of secondary recovery development. This was the Delaware Extension Pool of Nowata County, Oklahoma,[1] which was unitized by I. L. Dunn and J. O. Lewis in 1926 after two years of efforts. These men were instrumental in development of the "Marietta" process by which gas repressuring was then known. In this instance, unitization was accomplished by formation of a new company to acquire operation of leases comprising approximately 4000 productive acres which were at their economic limit of profitable operation. Owners of the leases accepted stock in the new company in proportion to the daily productive capacity of the leases. A centrally-located repressure plant was built to serve the entire acreage and results of gas injection were soon apparent in several-fold production increases. The venture has been highly successful.

Recognition of the benefits to be derived from the pooling of interests for application of secondary methods is responsible for 15 unitized projects in the Bartlesville "shoe string" sand pools of Greenwood County, Kansas. These pools, at 2000 feet in depth, were discovered in the early 1920's, and by 1936, when the first unit was formed, the production per well had decreased to about two barrels daily. The first four units were formed for gas repressuring activities, but the 11 units formed since 1942 have been for the application of water-flooding.

These units comprise a total productive area of approximately 6200 acres. Production without secondary recovery would be about 650 barrels daily in comparison to the actual production of 7000 barrels daily, with as yet only a minor portion having been developed for water-flooding. There is an average of 5½ partners in each unit. Equities were determined by three factors: accumulated production, number of wells, and current daily production, with equal weight generally given to each factor.

Benefits of Unitization

As an example of the benefits of unitization the instance is cited of one pool in the Greenwood County area, comprising approximately 700 productive acres, in which the working interest was entirely unitized, with eight operators participating. This unit was completely developed for water-flooding over a period of three years with 79 new wells drilled, water supply developed, and surface pumping equipment, lead lines, and tank batteries totally replaced. Because of the unit operation the amount of new capital required for the entire development averaged only $23,000 for each partner. This sum would have drilled only three input wells for each partner under individual operation. Annual production of this unit for the year 1945 was as high as any previous year in the pool's history, even considering the flush production period following discovery of the pool in 1922.

Advantages of working interest unitization are listed as follows:

1. Spreading costs of engineering in-

Investigate BETHLEHEM'S COMPLETE SERVICE on

CLOSED-DIE FORGINGS

If you are in the market for drop, press, or upsetter forgings, let Bethlehem review your needs and submit a quotation. You will find that Bethlehem has much to offer in this field, and that our facilities are among the best in the business.

When you order from Bethlehem, you have your choice of carbon or alloy steels, available from our own plant; you have the services of expert die-sinkers; you have ready for your job a wide range of modern forging equipment, including steam and board drop hammers, mechanical presses, and upsetters. Heat-treating methods conform to the best metallurgical practice. Inspection of finished work is thorough.

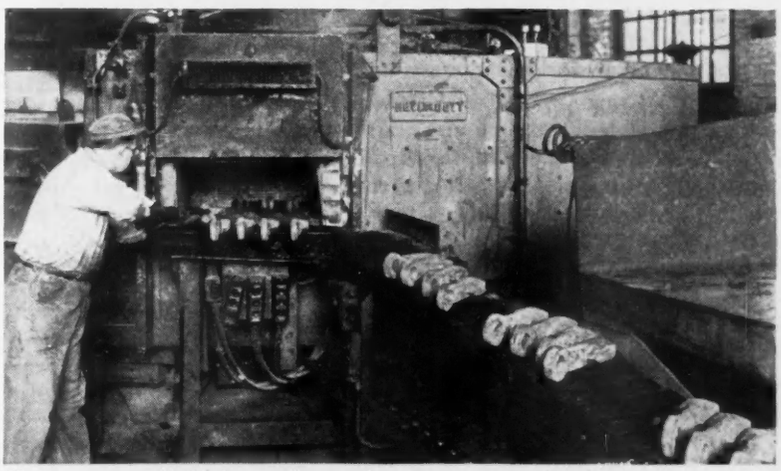
An order placed with Bethlehem is in competent hands. We would welcome the opportunity to bid on your work and to tell you more about our services.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

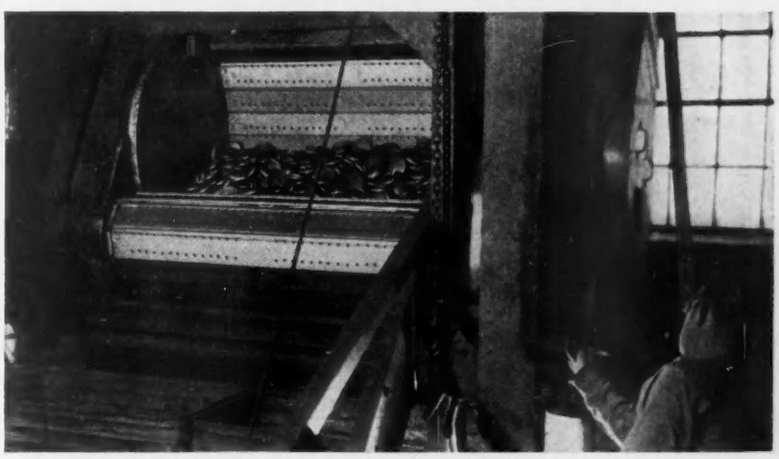
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

★ BETHLEHEM STEEL ★

2000-ton press, one unit in Bethlehem's battery of forging equipment.



Heat-treating at Bethlehem is done with extreme care and under precise controls.



Shot-blasting an order of drop forgings prior to inspection.

vestigation, core testing, and pilot flood operation.

2. Reduction of contract rates for drilling and construction.

3. Better equipment prices by quantity purchasing.

4. Permits standardization of equipment and attendant reduction of replacement and standby equipment inventories.

5. More efficient use of labor due to larger operation.

6. Elimination of duplication in water or repressure plants resulting in lower investment and operating cost per barrel or per Mcf capacity.

7. Cheaper power rates.

8. Reduction in well servicing equipment and more efficient use of operating personnel.

9. Location of central plant at most advantageous site in pool.

10. Elimination of duplication of administrative, legal, accounting, supervisory, district engineering and camp expenses.

11. Permits operation with the benefit of advice and experience of the combined talents of all the partnership interests.

12. Increased recovery by operation to lower economic limit and development of "leaner" areas by reason of lower operating and development costs.

Additional benefits to the operators resulting from unitization of royalty interests under the working interest unit:

1. Consolidation of tank batteries with accompanying reduction in investment in tanks, stairways and walkways, road construction, site damages and grading, oil treating facilities, and pumps necessary to return the produced water to the input system. In addition there will be a reduction of operating expense in labor for operation of batteries and maintenance of batteries and roads.

2. Well spacing, location of injection wells, and fluid movement control can be applied to obtain the full benefit of operation of the pool without the restriction of respecting property lines.

3. Higher oil gravity possible by operation of a central tank battery. Even though the gravity increase may not command a higher crude price, an increase in oil volume of approximately 2½ percent is obtained for each one degree API gravity increase.

Royalty Owner's Advantages

Advantages to the royalty owner:

1. Assurance that secondary recovery methods will be applied.

2. Increased income resulting from lower economic limit of operation.

3. Development of "leaner" acreage because of lower development cost.

4. Recovery of the maximum amount of oil along lease boundary lines.

5. Improvement in gravity and volume of the oil.

Equity Factors—Working Interest Units

In establishment of percentage participation in a working interest unit for secondary recovery there is no set of factors or standard formula which can be applied universally. Factors which may be fair in some pools may not be applicable in others. The proper approach to determination of equities is the selection of the factor or combination of factors which will more accurately represent the future value of the individual leases in a secondary program. Such factors should be as simple as possible, easily understood, and readily obtainable.

Some of the more commonly suggested factors are oil-in-place, recoverable oil content, accumulated oil production, acre-feet of pay sand, productive acreage, number of wells and current daily production. Certain of the factors which are readily obtainable in some pools may not be usable in others due to incomplete records. The first five factors are each indicative of relative secondary recovery reserve of leases. The last two factors represent other elements of lease value. Any one of the first five may serve alone as the basis of equity determination or in combination with one or both of these last two.

A discussion of the application of the various factors follows:

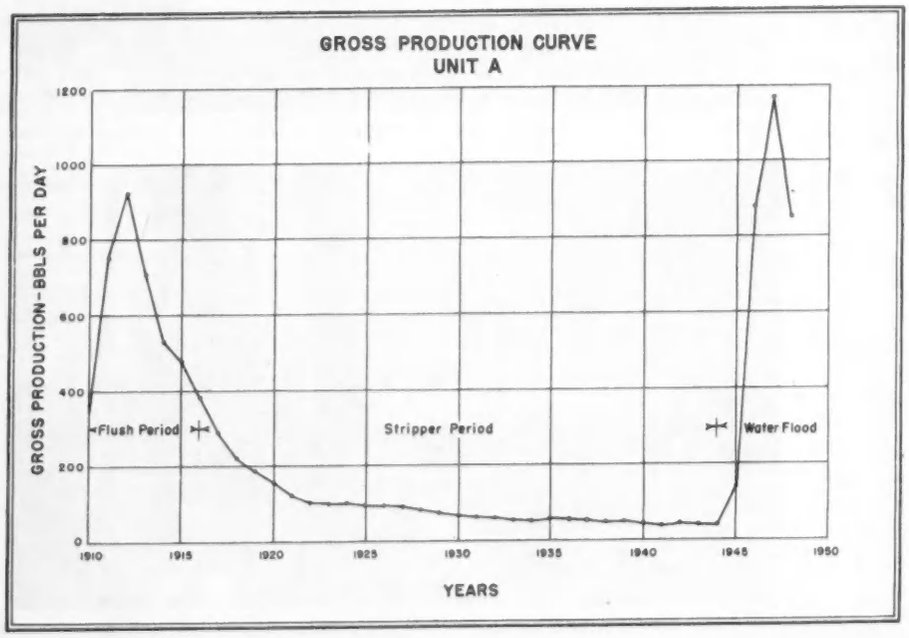
1. OIL-IN-PLACE: In pools where oil saturation data obtained by core analysis is representative of the actual oil saturation of the reservoir an oil-in-place figure can be determined. In reservoirs where representative oil saturation data are unobtainable due to flushing of cores but a fairly accurate connate water value can be obtained by coring with oil-base fluid, the oil-in-place can be calculated if data are available on past oil production and oil shrinkage due to release of gas from solution.

This method involves considerable exploratory expense which some operators in the pool might be reluctant to incur before the feasibility of secondary recovery is adequately tested.

2. RECOVERABLE OIL: This is a refinement of the oil-in-place factor and involves usage of a residual-oil-after-flooding figure as well as a minimum-floodable-permeability value. It can be used only where oil saturations of cores are representative of reservoir conditions. For instance, in a certain pool to be unitized for water-flooding, recoverable oil might be defined as the oil content in excess of the content represented by 25 percent of the pore space in sand sections having permeability greater than 10 millidarcys, thereby excluding the oil content which may be expected to remain in the reservoir after flooding. The oil content of zones having low saturations such as gas caps or water encroached sands are thereby eliminated from the equity calculation.

3. ACCUMULATED OIL PRODUCTION: In gas-expansion-depletion type pools, this is a measure of the relative reservoir pore volume of individual leases and criterion of the reserve available by secondary methods. The past production of areas subjected to edge water encroachment or abnormal drainage will require separate consideration.

4. ACRE-FEET OF PAY SAND:



Such information is usually readily obtainable from well logs and is an acceptable basis if porosities and connate water contents are considered fairly uniform over the pool. Gas caps and water encroached areas should be accorded special treatment.

5. PRODUCTIVE ACREAGE: This is easily determinable but does not give weight to sand thickness. In the absence of data on the previous four factors it can serve as a measure of reserve.

6. NUMBER OF WELLS: This factor gives weight to lease salvage value which may be considerable in the deeper areas where several strings of casing are employed. In the shallow areas drilled 30 or more years ago the salvage value of a well is usually negligible. Where existing wells are to be abandoned and all new wells drilled in the proposed secondary recovery program, this factor will have no import on the future value of the lease. In instances where the old wells are to be used, this factor exacts a penalty of the operators who have abandoned wells that will have to be redrilled by partnership funds.

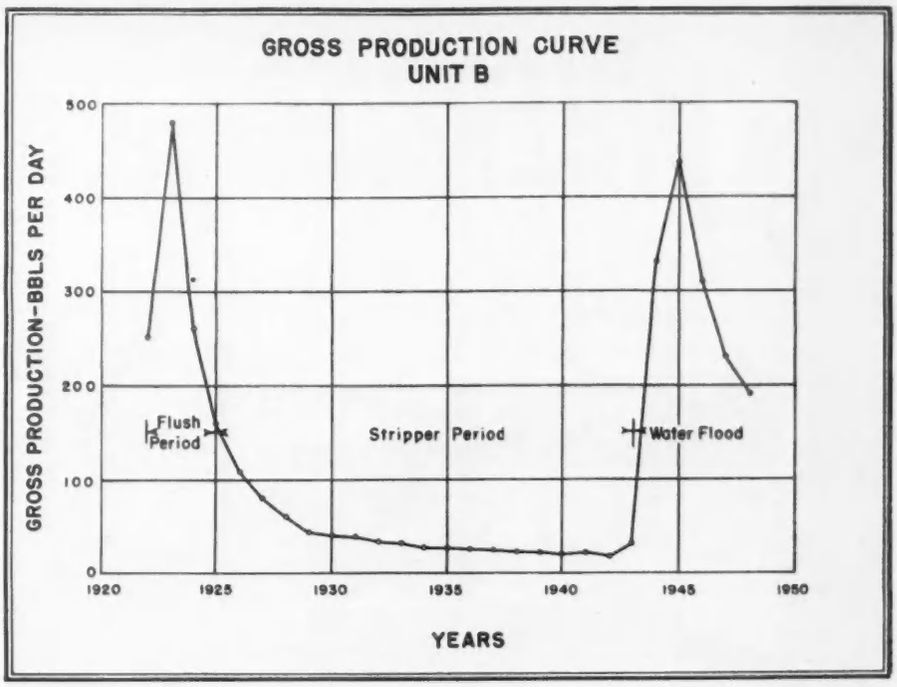
7. CURRENT DAILY PRODUCTION: This is an index of the earning value of a property and serves as a stabilizing factor to protect a high income property from excessive loss of revenue prior to obtaining production increase should the other factors used in the unitization formula be less favorable. Where production is artificially stimulated or is otherwise out of proportion to the estimated reserve, provisions may be made to allow each partner to retain his own production until his proportion of the total production calculated on his percentage interest exceeds the production of his individual lease at the time of unitization.

It should be possible to select from the preceding list the factors most applicable to any particular pool, keeping in mind those factors which will be most readily acceptable and least controversial.

Equity Factors—Royalty Units

All of the factors involved in determination of working interest units are adaptable to royalty interest units with the exception of those which allow credit for value of equipment. The royalty owner is usually not too well versed in problems of oil production and may be skeptical of any unitization plan which would cause immediate decrease of his monthly royalty check. For this reason the simplest factor would be current daily production.

Nine secondary recovery projects in Greenwood County, Kansas, have either partial or complete royalty unitization. These units were formed using the factor of current production as the equity basis. Such equities, in this area, agree quite closely with the working interest equities calculated on the three-factor basis.



In the Coody's Bluff area of the Nowata, Oklahoma pool, royalty interests were unitized over an area of 430 acres using the factor of oil-in-place exclusive of the oil in those portions of the sand having horizontal permeability of less than 10 millidarcys. Nine core analyses were available for determination of equities which were calculated from a contour map drawn on oil content.

Operating Agreement

The working interest units function under an operating agreement which follows in general form the Unit Operating Contract (Committee Form) which is contained in the Handbook on Unitization of Oil Pools[2] issued by the Mid-Continent Oil & Gas Association in 1930.

After partnership interests have been established to the mutual satisfaction of all parties, titles are exchanged, examined, and requirements satisfied, if necessary. Unitization is then accomplished by assignments of leases by each party to the other parties to the end that each of the participants will be vested with an undivided interests in all the leases and equipment thereon in the unitized area. The agreement can be terminated only by unanimous consent of all parties; however, any party may at any time dispose of his interest, with the other parties having first option on the right to purchase.

The agreement provides for creation of an operating or advisory committee comprised of one representative of each partnership interest with voting power proportional to ownership percentages. A committee vote of some majority interest, such as 60 percent, is required to be binding on all parties. The majority requirement is usually so regulated that the vote of two or more interests is necessary to constitute a majority. The operating committee has the power to substitute and replace the operator with another of the interested parties if such procedure ever becomes desirable. Other functions of the committee consist of approving or disapproving expenditures in excess of some specified sum and disposition of surplus materials and equipment. A schedule of standard accounting procedure, Mid-Continent Committee Form 2-B, is attached to and made a part of the operating agreement. Provisions for allocation of overhead and district expense are included in the schedule. Partners are furnished monthly an itemized statement of expense and a report of operations which includes production and input data, well tests, and items of general interest.

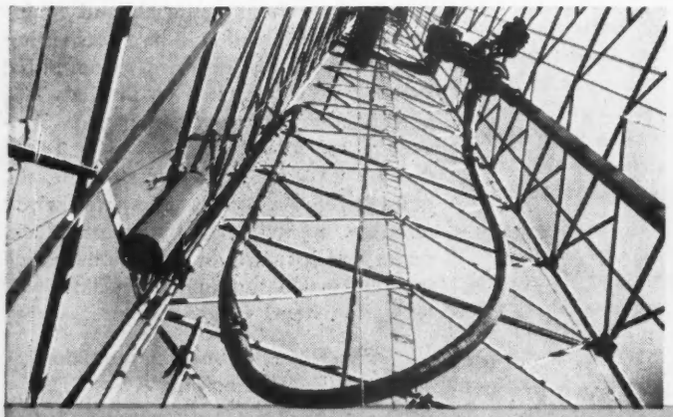
State Recognition of Unitization Principles

The principles of unitization and their benefits in conservation practices have been recognized by various state regulatory bodies.

The Oil and Gas Conservation Law, Act 105, enacted in 1939 by the Arkansas General Assembly authorized the establishment of units for the development and operation of pools when such were made in the interest of conservation,

WHEREVER petroleum men

Hewitt Oil Suction and Discharge Hose is faster-flowing, safer, more dependable. This smooth-bore hose is 10% lighter in weight than rough-bore hose and is far easier to handle. Its smooth, oil-resistant inner tube resists deteriorating effects of petroleum products and minimizes frictional drag. High-tensile wire reinforcement, imbedded in rubber, prevents expansion under pressure or collapse under suction. Special Hewitt curing process will not allow the tube to break loose.



At the derrick

Hewitt Rotary Drilling Hose cuts your operating costs. That's because it brings you the strength of steel and the flexibility of rubber. It is specially built for today's higher drilling pressures. It is tough enough to resist scouring drilling muds . . . yet it's flexible enough to stand constant bending.

At the refinery

Hewitt Tank Car Hose speeds your bulk movement of petroleum products. Its all-synthetic, oil-resistant tube and cover make it ideal to use where the inside and outside of your hose are in contact with gasoline or oil. Its smooth-bore tube assures you fast flow under pressure or suction.

need dependable hose . . .

they rely on Hewitt Hose engineered to meet their specialized needs

Whatever the job may be, you can always depend on Hewitt Hose to give you the utmost in performance.

You see, the complete line of special-purpose Hewitt Hose is *engineered and manufactured to meet your exact needs.*

Your investment in Hewitt Hose is safeguarded by the constant practice of:

Continuous research. It is no mere chance that Hewitt has brought you so many "firsts" in hose design and construction. It is the result of long and constant research by expert Hewitt technical men.

Careful testing. Hewitt engineers are always giving Hewitt Hose exhaustive tests to make sure that it measures up to your every need.

Field service. Trained engineers in the field help you select the *right* Hewitt Hose for your particular job. These men keep Hewitt informed of your changing needs, too.

HEWITT OFFERS THE OIL INDUSTRY A COMPLETE LINE OF SPECIAL HOSES

For drilling:
- Rotary Drilling Hose
- Flexible Vibration Hose
- Mud Pump Suction Hose

For refining:
- Oil Suction and Discharge Hose
- Sea Loading Hose
- Barge Loading Hose
- Fire Hose
- Flue Cleaning Hose
- Steam Hose

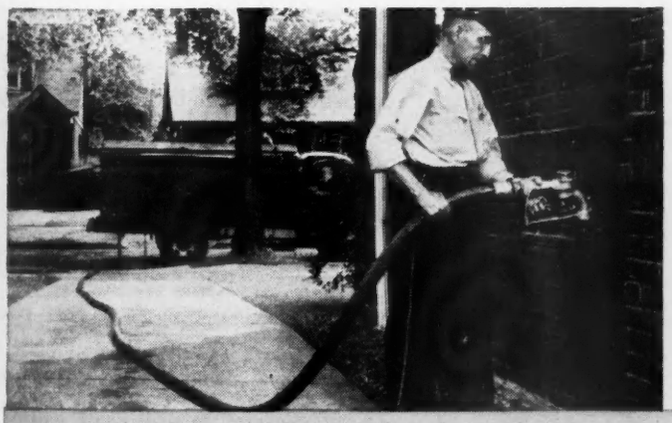
For distributing:
- Tank Car Hose
- Tank Truck Hose
- Fuel Oil and Distillate Hose
- Gasoline Pump Hose

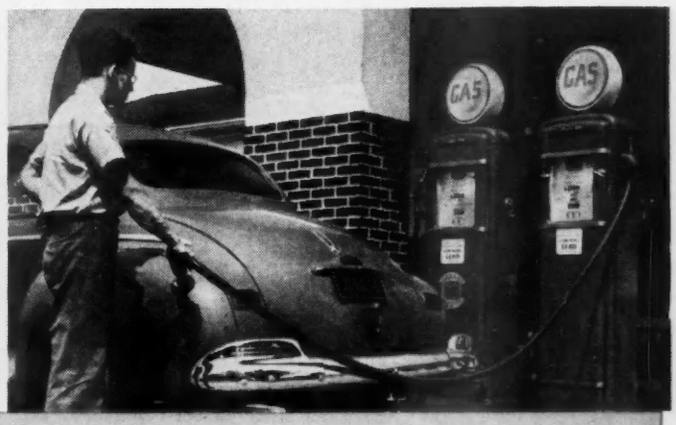
Also Propane-Butane Hose for all types of service

HEWITT HOSE for the OIL INDUSTRY

HEWITT RUBBER DIVISION, BUFFALO 5, N. Y.

HEWITT-ROBINS HR **INCORPORATED**





At the truck **Hewitt Fuel Oil and Distillate Hose saves you time and trouble** in delivering fuel oil or gasoline under pressure. Its carcass is especially compounded for that type of service. And its cover resists abrasion, weathering, and the rotting action of oil and gasoline. This hose is light and flexible for easy handling, too.

At the pump **Hewitt Gasoline Pump Hose resists the destructive effects of gasoline** . . . will not discolor your fuel. Has a smooth bore for speedy flow of fuel. Stays flexible even in coldest weather. Multiple plies of extra strong braided cord . . . bonded with synthetic rubber . . . resist crushing, pulling or expansion.

subject to approval of the Oil and Gas Commission. The Jones Sand Unit of the Shuler field, Union County, Arkansas,[3, 4, 5] was approved by the Commission when the royalty agreement had been executed by owners of 75 percent of the royalty interests. Eventually, practically 100 percent of the royalty owners signed the agreement.

The Louisiana Department of Conservation, by authority of the power delegated to it under Act 157 of the 1940 State Legislature issued orders to make unitization effective in the distillate reservoirs of the Cotton Valley[6] and Erath fields and in two separate oil reservoirs in the West Tepetate pool[7] upon petition of owners of a major portion of the working and royalty interests.

Oklahoma's Unitization Law, House Bill 339, passed in April, 1945, provides specific regulations for procedure in accomplishing unitization and is a far reaching step in the advancement of conservation practices. Upon petition of lessees of 50 percent or more of the area of the common source of supply sought to be unitized and presentation of a plan of equitable unitization, the Corporation Commission will grant a hearing, and, if such plan is found to be in the interest of conservation, will enter an order creating the unit. If lessees owning 15 percent or more of the area embraced by the Unit file written objection to the plan within a period of 60 days after the order is entered the unit will not be created.

House Bill 339 excludes pools in which secondary recovery methods are being applied and also those which were discovered more than 20 years prior to the effective date of the law. Thus, unitization must continue to be entirely voluntary in the older Oklahoma pools; however, the groundwork is established for facilitating future secondary methods in the more recently discovered pools. The Commission has authorized and approved creation of six units under the unitization law.

Cooperative Agreements

Cooperative agreements between lease owners for simultaneous prosecution of secondary recovery efforts have been in general use for a number of years. Such consist mainly of agreements concerning the placement of injection wells along lease boundary lines with provisions governing the volumes to be injected thereto and, in instances, providing for supply of the injection medium from a plant or system of one of the operators.

Such mutually beneficial contracts, while commendable, contain only a minor semblance of the elements of cost savings that characterize a completely unitized effort. There is still considerable duplication of items of development and operating cost.

These agreements are generally dependent for enforcement only on the good will and faith of the signatory parties. A change in management or economic viewpoint of one or another of the parties may have a marked effect on the workability of the agreement. Under unitization the will of the majority, which should, by the law of averages, be the best policy, will prevail in governing the policies of development and operation.

Conclusion

The benefits and workability of unitization have been discussed. It may be difficult for operators to relinquish personal supervision of their leases. This is a recognizable inherent American trait, particularly in the oil industry which was fostered in a strictly competitive economy with the law of capture the only rule for guidance. It is likewise understandable that each operator considers his leases and equipment to be of greater value than his neighbors' and believes his equity should be altered to reflect this situation. Such objections, when viewed realistically, are usually of minor importance in comparison with the benefits which would be obtained under unitization, particularly if the stripper operation is marginal and the prospects of continued profitable operation under existing methods are unfavorable.

Most of the operators in stripper pools are aware that their properties have potential value for secondary recovery but many are waiting for improved recovery methods or proof of the feasibility of the process in their own particular pool. The merits of such course of action are understandable, however, in the old fields each succeeding year brings its increasing toll of casing failures, allowing upper waters to intrude into the producing formation if the well is not repaired immediately. The history of water flooding is replete with instances in which such encroachment prior to application of planned flooding is detrimental to recovery of oil. In producing wells the existence of casing leaks may be readily determined but on shut down wells, which are numerous in all stripper areas, casing leaks may not be found for several months and irreparable damage done in the meantime. The possibility of losses while waiting for more favorable conditions may far outweigh the advantages.

It is advisable therefore, that the operator of stripper leases take inventory of his assets in potential secondary reserves and discuss the matter with other operators in the pool to the end that a joint venture be worked out for application of secondary methods. Only by unified effort will the maximum recovery and profit be realized.

About the Author

W. A. HEATH graduated from the University of Pittsburgh in 1929 with a B.S. degree in Petroleum Engineering and obtained his early experience in secondary recovery in Pennsylvania. In 1936, he became associated with Phillips Petroleum Company at Bartlesville, Okla., and was active in development of water-flooding operations in northeastern Oklahoma and eastern Kansas. He was made assistant division superintendent in 1938 and chief water-flooding engineer in 1940. In 1946, he resigned from Phillips to become associated with Earlougher Engineering, Tulsa, petroleum consultants specializing in water-flooding and secondary recovery operations. He is chairman of the Mid-Continent District API Secondary Recovery Sub-Committee and chairman of the Kansas-Oklahoma Water Flood Operators group.

REFERENCES

[1] I. L. Dunn and J. O. Lewis, Unit Operation Delaware Extension Pool, Oklahoma API Bull, Vol. 10, No. 2 (1929) p. 37.

[2] Handbook on Unitization of Oil Pools, Mid-Continent Oil & Gas Assn., p. 87.

[3] J. E. Howell, A Practical Example in Unitization and Repressuring, Oil Weekly, April 27, 1949, p. 28.

[4] H. H. Kaveler, Engineering Features of the Shuler Field and Unit Operation, Trans. AIME (1944), Vol. 155, p. 58.

[5] G. R. Elliott, Geologic Factors in Unitized Pressure Maintenance, Jones Sand Reservoir, Shuler Field, Arkansas, Bull. AAPG Vol. 28, No. 2 (Feb. 1944).

[6] George Weber, Cotton Valley Project Outstanding Example of Unitized Operation, Oil and Gas Journal, July 10, 1941, p. 56.

[7] W. L. Horner and C. W. Ziemer, "West Tepetate, Louisiana" Oil and Gas Journal, March 10, 1949.

CHIEF Paraffin Solvent

(Patent Pending)

Now is the time to prepare against cold weather by removing the paraffin from the tubing in both pumping and flowing wells, lead line and tank bottoms by using CHIEF Paraffin Solvent. Again and again and again we have been told that OUR Paraffin Solvent is the best and that it DOES increase production.

ABSOLUTELY GUARANTEED IF USED AS DIRECTED

"Chief of All"

Copyrighted 1947 by The Indian Chemical Company, Registration No. K 12225

Manufactured by

The Indian Chemical Company

Distributed by

GLOBE SALES COMPANY

704 VIRGINIA AVE. **WICHITA FALLS, TEXAS** **P. O. BOX 193**

The Foreman's Responsibility in

Employe Indoctrination

By RICHARD PETERS

Regional Employe Relations Manager, Humble Oil & Refining Company

GOOD EMPLOYE relations and efficient operations are the rewards to be expected by managers and foremen from well planned and executed programs of employe indoctrination. Managers need to recognize their indoctrination function in their organization, and foremen have the responsibility of recognizing it in dealing with their work groups.

This article was prepared for The Texas Manufacturers' Association's Foremen and Supervisory Institute, Southern Methodist University, 1948-49.

FOREMEN who are studying the employe indoctrination function for the first time find it is work they have been doing for years in the normal performance of their supervisory duties. The subject can be segregated for the purpose of study, but for the purpose of operations it should be left as an integrated part of the foreman's total employe relations function.

A broad definition of indoctrination includes the teaching processes applied to any employe, old or new, who is making a personal adjustment to a new job or to a new situation in an established job. Some authorities hold that employe indoctrination is a continuing function that exists as long as any adjustments are to be made. Others center their thinking around the adjustment at the time of employment. This limited interpretation is more properly called "induction." A foreman's interest centers primarily around the induction and early indoctrination periods of employment.

The induction phase of indoctrination affords a company its initial opportunity to create proper attitudes and impressions in an employe. Employe relations influences take over from public relations the job of creating attitudes and impressions when application is made for employment.

Under competent direction an employe indoctrination program can be used as a means for:

1. Reaching a normal productive level quickly.
2. Establishing receptiveness to training.
3. Creating an initial proper relationship between worker and foreman.
4. Influencing inplant human relations.
5. Reducing production costs.
6. Reducing training costs.
7. Maintaining employe morale.
8. Lowering labor turnover.
9. Creating incentive.

The incentive for work created during an employe's introduction to the company will pay larger and more lasting dividends to the company and the new employe than the monetary type incentive if the information used in creating is factual. Over-emphasis on promotional opportunities, earning possibilities, security, and the "one big family" approach to incentive is not good indoctrination and inevitably results in a post-induction disappointment that becomes evident in employe morale and in production costs. Most employes seeking work would rather join a progressive industrial organization than "one big family."

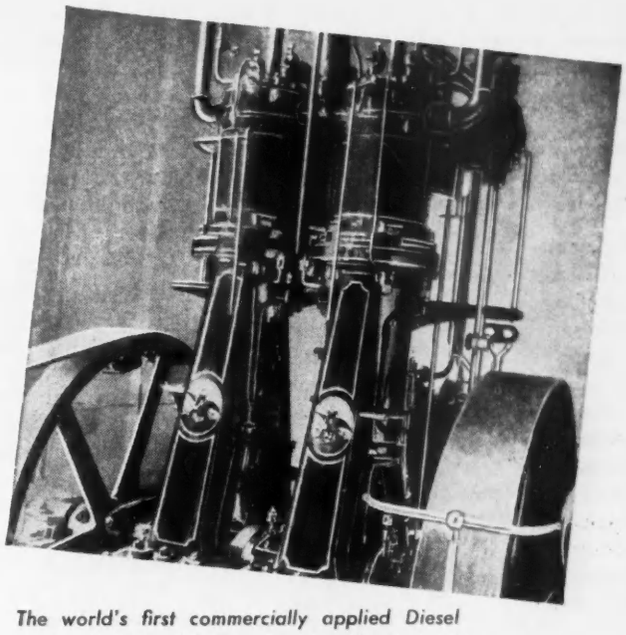
The most immediate result of a good program will be evident in good human relations. Industrial managers have learned that the small amount of money spent on establishing good human relations always results in a profit for the company if the human relations activities are under practical and competent direction. A foreman's managerial functions of planning, organizing, directing, coordinating, and controlling can be made easier through the use of a well-planned indoctrination program principally because of the effect of the program on the employe in creating in him a receptive attitude toward supervision. Under some conditions a simple indoctrination program will accomplish the objective faster and with more permanent results than an elaborately designed program. Managers or their staff assistants who design indoctrination procedures need to aim their efforts directly at the objective of giving employes information in such a way that it will be understood and retained.

Managers and foremen who study employe indoctrination will find that it is an activity that has been going on in their company and in their small work groups for a long time. For a number of years employes have been getting started on their jobs and have been making personal adjustments to new work situations. In some cases the adjustments are well planned and occur with a minimum of confusion to the employe. In other cases an observer can find evidence of the "left handed monkey wrench" and "sky hook" days. Some employes learn the hard way just as their foreman did years ago. Some supervisors use sink-or-swim indoctrination methods because they consider themselves living examples of the success of that type of personal adjustment. Smart managers and foremen are planning their indoctrination activities because they can see the results in increased production and reduced costs.

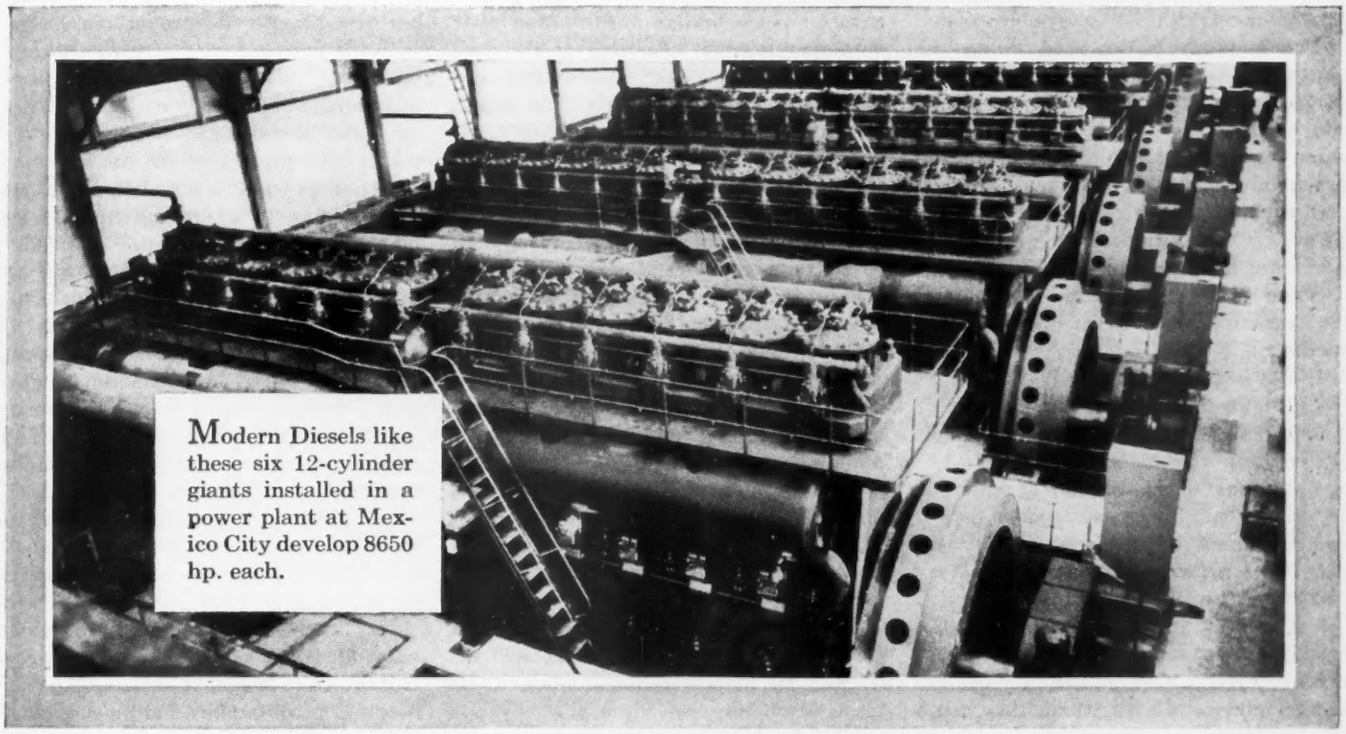
A well-planned program outlines the subjects to be included, the methods to be used, and places the responsibility

Dr. Diesel's Big Idea

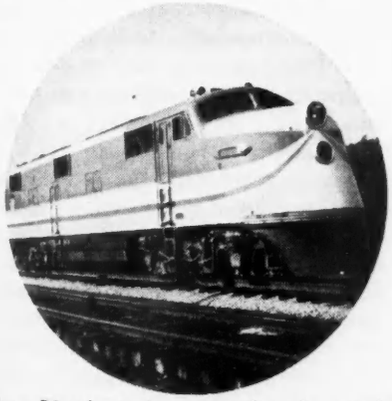
How petroleum progress helped develop a new type of power



The world's first commercially applied Diesel engine, built by Adolphus Busch in St. Louis 51 years ago.



Modern Diesels like these six 12-cylinder giants installed in a power plant at Mexico City develop 8650 hp. each.



Today Diesel engines are largely supplanting steam on the railroads. Giant Diesels develop electricity, power ships. Lightweight Diesels power trucks, buses, contractor's machinery and other units.

Eliminating spark plugs and carburetor, Dr. Diesel in 1892 patented an internal combustion engine designed to run on cheaper, heavy fuels. But years of research were needed to make the idea practical. Engineering research had to find ways to reduce weight and solve the difficult problem of injecting the fuel against high pressure. Petroleum research had to develop lubricants to reduce the fouling of pistons, rings, cylinders and valves under the intense heat and pressure—a field in which Texaco has been pre-eminently successful.

THE TEXAS COMPANY

Petroleum Promotes Progress

TEXACO

for the indoctrination function. The easiest and quickest way to determine the subjects to be included is to ask some employes for suggestions from their point of view, and some foremen and supervisors for their suggestions. Subjects listed by foremen from various industries in a recent conference included:

Accidents	Overtime
Associates	Pay
Benefits	Patents
Bonus	Privileges
Bosses	Products
Clothing	Promotions
Clubs	Rest Rooms
Deductions	Rules
Discounts	Savings
Employe Activities	Security
Expenses	Schedules
Hours	Suggestions
Industry Terms	Telephone
Insurance	Time Off
Job	Transportation
Lunch	Union
	Visitors

The methods to be used in an organized program need careful and expert planning. The advice of experienced educators, training specialists and in some cases psychologists can help the program reach the objective. Technical and theoretical advice should be tempered by the practical suggestions of operating foremen and supervisors.

Some points to consider in outlining the induction phase of an indoctrination method:

1. Physical surroundings.
2. Intelligence level of employes.
3. Intelligence level of the person directing the indoctrination.
4. Volume of instruction at any one time.
5. Grouping of subjects.
6. Type of work.
7. Size of group being instructed.
8. Group or individual instruction.
9. Timing.

New employes are unusually receptive to the influences with which they come in contact during the period of personal adjustment. Doctors explain the physiological and mental condition that exists by saying that the adrenal glands in a person's body "tone up" various body functions during periods of personal adjustment. Managers and foremen planning an indoctrination program will do well to see that the new employe is subjected to favorable influences because the impressions gained while the mind and body are in such a receptive condition are lasting ones.

Physical surroundings contribute materially to the success or failure of the program. Ringing telephones, machinery noise, and interrupted conservations interfere with the continuity of foremen's and supervisors' jobs and detract from the success of the indoctrination function. The hurry-up methods experienced by new employes are often responsible for initial bad impressions.

Simple methods accomplish the objective more effectively than intricate and elaborate methods. In planning indoctrination methods it is well to consider the effectiveness of simplicity regardless of the intelligence level of employes coming under the influence of the program.

Training experts, psychologists and professional educators have learned that the average mind can absorb only a certain amount of information at one time. Dr. Harold S. Hulbert told members of the National Safety Congress in 1940 that the capacity of the minds is 14 ideas relative to one subject, and more make for confusion. He also said that each point should be taught seven times in seven ways and that two weeks should elapse between each teaching. Successful indoctrination programs have made effective use of information of this nature. They outline information that employes need at the time of the preemployment interview, on the first day of work, at the end of the first week, the first month, 3 months, 6 months, 9 months and so on at intervals less uniform after the first year of employment.

Some companies are now studying a method of indoctrination to be applied to retiring employes. Certainly the personal adjustment that occurs when employes cease active work and retire is a most difficult one and any work done on this final phase of a company's indoctrination program should contribute materially to the employe relations of annuitants.

The indoctrination method should include the consideration of the grouping of subjects. The learning process functions easier if similar subjects are grouped together.

The type of work being done by an employe or group of employes will influence the indoctrination method to be used. Methods used for machine shops cannot be applied in indoctrinating retail store clerks nor can farm employes be indoctrinated by the same methods applied to oil field employes who work in groups. The type of work and the size of the organization will determine whether the program is applied individually or in groups.

The foreman's responsibility in indoctrination is more closely allied with the functioning of the program than the developing of it. Managers need to determine the scope and methods of indoctrination and then delegate the responsibility for the function. When responsibility is delegated it is not given away. A supervisor cannot shift his responsibility to a subordinate, but he can delegate it and at the same time maintain his full responsibility for the function. A foreman should be delegated responsibility for indoctrination in the same degree that he is held responsible for other managerial functions. Foremen who work in an organization where no organized indoctrination program exists can apply the fundamentals of good indoctrination to their own work group. When a foreman does this on his own initiative he becomes involved in the developing stage of the function. Foremen who initiate indoctrination programs based on sound principles may expect recognition from higher supervisors because of the positive results that follow organized indoctrination.

Foremen who share the responsibility of an integrated program have no less responsibility for doing the job well than those who follow their own program. Managers have much to gain by assigning as much as possible of an integrated program to foremen. A new employe who is forming lasting impressions will be brought into the proper relationship with his foreman quicker if the foreman is active in the early phases of indoctrination. The results are better if the personnel department representative places the employe under the foreman's direction as soon as possible, and allows the foreman to show the employe the plant, introduce him to the "big boss," and generally direct the induction. Parts of the indoctrination may of necessity need to be done by staff specialists. If so, the foreman maintains his position if the specialized indoctrination is done at his request, and he loses his position if staff specialists do the work and then take the employe to his foreman. The foreman's responsibility in an integrated program depends upon the part assigned to him. In plants where no program exists he has full responsibility for the indoctrination of his work group.

An integrated program needs to be controlled and the logical point of control is in the Employe Relations department. Control implies establishing standards of performance, checking progress and results, supplying information, analyzing conditions pertinent to indoctrination, and measuring the results of the program. These functions can be delegated to the employe relations staff, but responsibility for them, although delegated, remains with the line manager.

An organized followup is necessary to assure the success of any indoctrination program. It is particularly important in the formative stages of a program because expert and detailed planning does not always assure that the impressions and information are having the desired effect on employes. Adjustments may be required. An organized followup needs to be a continuing part of the program to assure its success.

Interpretative Petrology of Sedimentary Rocks

By DR. GORDON RITTENHOUSE
Department of Geology, University of Cincinnati

THE petrology of sedimentary rocks is a big subject, covering as it does in its broadest sense, the entire history of sediments from their source, through their transportation, deposition, and post-depositional changes. Just where the subject begins and where it ends is indefinite. Certainly the writer would include many things that the stratigrapher, the paleontologist, and the structrual geologists would consider part of their fields. Out of this broad, but poorly defined subject will be cut a small, irregular segment for discussion in this paper.

First it is desired to outline the general philosophy behind interpretative petrology, and then to show by examples how deductions from the composition texture, and structure of sedimentary rocks can provide information of value to the geologist in his work of discovering oil. Some examples are of properties that can be studied best at the outcrop, or with the aid of a hand lens or binocular microscope. Particular emphasis is given, however, to the examination of thin sections with the aid of a petrographic microscope, because it is felt that oil geologists are overlooking an exceedingly valuable tool when they neglect thin section work.

General Philosophy

For many geologists, the examination of an outcrop, a hand specimen, or a well sample is largely descriptive—the color, composition, texture, and obvious structures are noted in varying detail, and the rock is given a name. For many purposes this is adequate.

But this is only the first step in the study of sedimentary rocks. One can look at a rock and ask, "What properties does this rock have that will tell where it came from, how and under what environmental conditions was it formed, and how has it been changed since it was deposited?" Most rocks are made up of a large number of grains, and these grains have the individual properties of size, shape, roundness, surface texture, orientation in space, and a variety of other properties that are dependent on and can be grouped under composition. In the aggregate the particles have mass properties, of which porosity, permeability, bedding, and kind and amount of induration are examples.

Of these properties, some, like composition, may be inherited from the original source material; some, like shape and roundness, were developed as the particles were transported from the source to their place of deposition; some, like size, orientation and bedding, reflect the environment of deposition; and some, like porosity and permeability, at least in part reflect post-depositional changes.

THIS ARTICLE outlines the general philosophy behind interpretative petrology and shows by examples how deductions from the composition, texture and structure of sedimentary rocks can provide information of value to the oil geologist. Particular emphasis is given to the examination of thin sections with the aid of the petrographic microscope. Prepared for WORLD OIL, the article is based on a series of lectures delivered under the auspices of the American Association of Petroleum Geologists' Distinguished Lecture Committee.

Petrogenesis

To describe these properties as seen in an outcrop, a hand specimen, a well sample, or a thin section is not enough. These individual and mass properties provide clues from which the past history of the rock can be deduced with varying degrees of success. This reconstruction of the past history of rocks can be called interpretative petrology, or petrogenesis.

This interpretative method is not a new one—it has been applied for many years to the study of igneous rocks and ore deposits, and has paid handsome scientific and economic dividends. A more extensive application to sedimentary rocks should produce similar dividends, particularly in the search for and development of stratigraphic traps or combined stratigraphic and structural traps.

In applying interpretative methods it is neither necessary nor desirable to collect vast masses of descriptive data with the hope that after the data are available they will yield valuable results when analyzed. Instead, specific problems or questions should be considered and analyzed as to probable or possible implications. Then study should be directed to the collection of *critical* data that will prove or disprove one or more of the alternative explanations. The method of study that will yield the critical data with a minimum expenditure of time and money should be adopted. The hazards of unthinking application

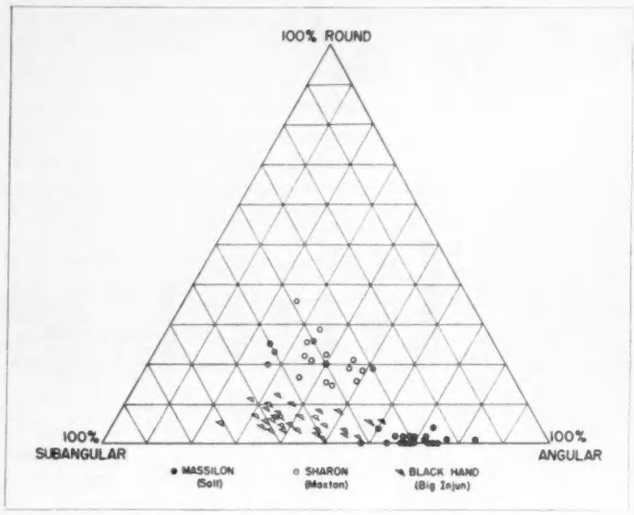


FIGURE 1.

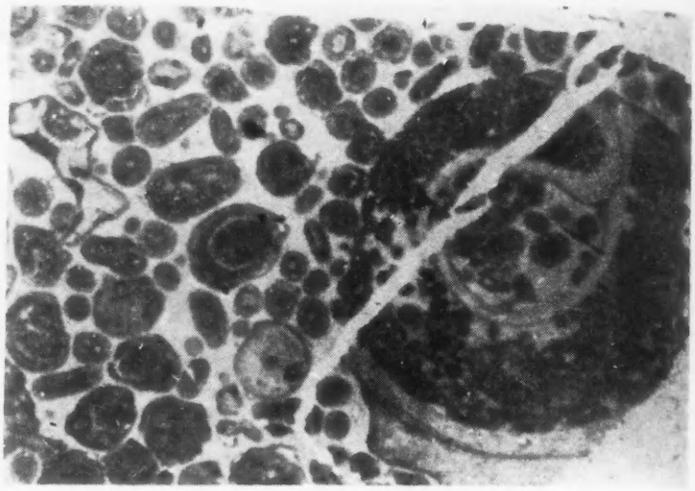


FIGURE 2.

of routine methods, which may have supplied useful information elsewhere, cannot be overemphasized.

Grain Roundness

In the Appalachian Basin, the roundness of heavy minerals has been an exceedingly valuable tool for correlating beds, for outlining petrographic provinces, and for reconstructing geologic history. Rounding refers to the roundness or angularity of the corners or edges of the grains, not to their shape or approach to spherical form. By comparison with a visual standard, grains were classed as round, subangular, and angular, and the percentages of each were plotted on a triangular diagram.

In Figure 1, the roundness of tourmaline grains of a very fine sand size from the Black Hand formation of Mississippian age and the Sharon and Massilon sands of Lower Pennsylvanian age have been plotted on such a diagram. The samples from each formation are in distinct groups in different parts of the diagram. Thus these formations that cannot be identified by fossils or megascopic characteristics can be correlated or differentiated by the rounding of their heavy minerals.

It can be argued that correlation of these formations is primarily descriptive. What about interpretation? Consider the Sharon—in it about 20 percent of the tourmalines are round, about 40 percent are subangular, and about 40 percent are angular. What does this mean regarding the past history of this sandstone?

In the process of rounding, the sharp corners and edges of an angular grain are worn off very rapidly at first. But as wear continues, the change in curvature of the corners and edges proceeds at a progressively slower rate. The change from subangular to round may take many times as long as the change from angular to subangular. We may conclude, therefore, that the round and angular grains in the Sharon could not have had the same history. The Sharon is a "mixed" sand, derived from two or more sources, one of which probably was a pre-existing sandstone or sandy limestone. Rounding, of course, is only one of the properties that contributes to our knowledge of the geologic history of the Sharon.

In Ohio the Sharon directly overlies the Mississippian-Pennsylvanian unconformity. It is suggested that sands containing a mixture of round and angular grains may be useful in recognizing unconformities elsewhere.

Clastic Limestone

Figure 2 is a magnified view of an oolitic limestone from the Greebrier formation in West Virginia. This figure and most of those that follow are photographs of thin section—rock slices about 0.03 millimeters in thickness. Slices of most sedimentary rocks are transparent and one would have no difficulty in reading this print through them. When studied with the aid of a polarizing microscope, such thin sections have three main advantages, namely, (1) higher magnifications (100 plus times) are possible and consequently the structures and textures of the rocks can be seen more clearly, (2) the optical properties of the minerals can be used to identify them, and (3) cross sections of the grains permit their internal characteristics to be studied.

In this paper, thin-section examination has been stressed, because the writer believes it can be applied more widely in exploration and development work in the petroleum industry. It should be emphasized, however, that as another helpful tool thin-section examination will supplement, but not displace, the other valuable tools that are used by oil geologists at the present time.

In Figure 2 some of the oolites have microfossils or fossil fragments as cores; in others, the centers are lime sand grains. Some of the oolites have had a number of concentric shells of carbonate deposited around the nucleus; others have only one or two concentric shells about the central core. The differences in centers and number of concentric layers of carbonate strongly suggest different histories for the oolites in this limestone.

In the upper left center of the photograph is an irregular-shaped fragment of lime containing parts of several oolites and lime sand grains that are held together by a fine-grained lime cement. This fragment has no concentric coatings of carbonate. It and the other oolites suggest derivation elsewhere (perhaps not very far) and transportation by waves or currents to the site of deposition.

Large Fragment

The relatively large fragment in the right of the photograph also tells a story. Originally, this fragment was a small snail. After the animal died, the shell was filled with calcareous mud and some small oolites. This material became so well compacted or cemented that when most of the outer shell was broken away (a remnant of the shell appears at the bottom), the mold retained its shape. Waves or currents provide the most probable means by which the shell could be broken and the fragments separated. Such waves or currents must have been strong enough to break the shell and to move the mud-filled fragment, which is at least one-fourth inch in diameter.

The history of the shell fits in with that of the oolites and the other frag-

BENNY ROBINSON, Party Chief on Crew No. 5, started digging shot holes for Independent right after he got out of Louisiana Tech 15 years ago. He has progressed through practically every job on a geophysical crew, having worked as shooter, recorder, surveyor, and computer, before being made a party chief. Such long and thorough experience is typical of the seasoned men who head all Independent Exploration crews, where the average experience of party chiefs is 15 years in seismograph field work.

It's a Deep Secret!

The location of oil reserves far below the earth's surface is one of nature's carefully guarded secrets. For 17 years a long list of important oil producers have depended on the experienced crews of Independent Exploration Co. for scientifically accurate recording and interpretation of this essential subsurface data.

POINTING THE WAY
IXC
FOR THE DRILL

Independent
EXPLORATION COMPANY
Geophysical Surveys
ESPERSON BUILDING HOUSTON, TEXAS

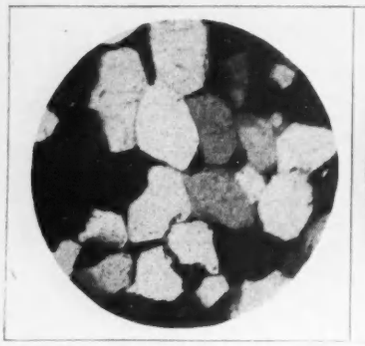


FIGURE 3.

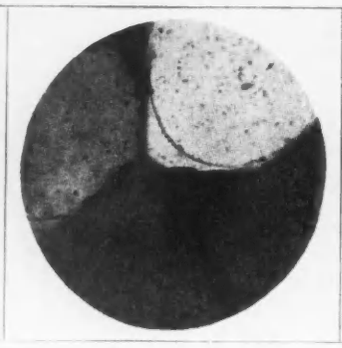


FIGURE 4.

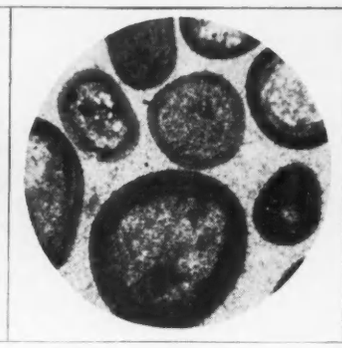


FIGURE 5.

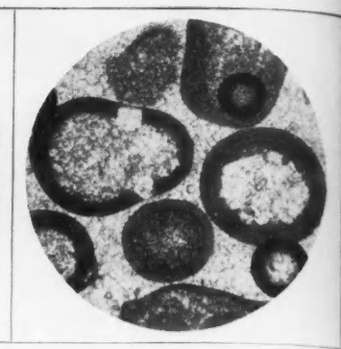


FIGURE 6.

ment, namely, that this oolitic limestone is a clastic rock—one in which the particles were formed elsewhere and transported to their place of deposition. Such clastic limestones are not uncommon, and some of them, like the Greenbrier of West Virginia and the McClosky of Illinois and Kentucky, are oil and gas producers. In locating new fields or extending old ones in such limestones, it is important to understand the implications of clastic texture. The clastic limestones are formed in the same way as other sandstones. They may have accumulated as bar, beach, dune, or channel deposits, and as such, will have the same shape, thickness, and trends as quartz sands deposited under the same physical conditions. Similarly, the original porosity pattern may be modified and complicated by a superimposed pattern of cementation.

Cementation

Interpretative petrology (and thin sections) offer a promising approach to a better understanding of "tight" sands. As deposited, well-sorted sands have porosities of 30 percent or more. Yet few oil sands have porosities that exceed 25 percent and in many sands the porosity is 10 percent or less. How and when was the porosity reduced?

Figure 3 is a photomicrograph of a quartz sandstone as seen under medium power (about x 50) of a polarizing microscope. The white, gray, and black appearance of the irregularly-shaped quartz grains is due to their differing optic orientation. The porosity of this sandstone is low—perhaps 10 to 15 percent—and the grains have an abnormal amount of contact with adjacent grains.

In some grains, faint, curved lines can be seen. At higher magnification (Figure 4) these lines can be seen more clearly. They are interpreted as "dust rings" of clay, iron oxide, or other fine-grained materials that formed coatings on the surfaces of the original grains. The quartz outside of the "dust rings" is a later addition, deposited in the pore spaces in optical continuity with the quartz of the original grains. This later quartz tends to build each quartz grain into a tiny quartz crystal. The relatively straight edges of the lightest colored grain in Figure 4 are traces of crystal faces that have been developed on this originally round grain.

In many sandstones, particularly those composed almost wholly of quartz, the deposition of quartz cement has been the major cause of pore-space reduction. Three theories have been advanced to explain how and when the silica cement was introduced. These are (1) introduction of silica by circulating waters long after deposition and burial of the sand, (2) deposition of silica from sea water at or very soon after the sand was deposited (advocated by Krynine), and (3) solution of silica at points of contact between grains and its redeposition in the adjacent pores (Waldschmidt). Which of these occurred in a particular sand may determine the pattern of porosity in that sand. If the porosity pattern could be predicted in advance, it would be of great help in exploration and development work.

Careful and thoughtful examination of thin sections, using the clues furnished by the rocks themselves to deduce their past history, will contribute greatly to understanding "tight" sands.

Alterations

Some sedimentary rocks are changed greatly after deposition, and the interpretative method must be used if the existence and significance of such changes are to be recognized. Figures 5, 6, 7, and 8 record a sequence of event in the Upper Arbuckle oolite from Carter County, Oklahoma.

Figure 5 shows oolites set in a fine-grained carbonate cement. Figure 6 is similar to Figure 5 except that in the oolite to the left, the concentric shells are cut by two carbonate crystals. In the oolite to the right, the same sort of truncation of the shells is shown less clearly. Apparently, this replacement or recrystallization is proceeding outward from the center of the oolites. In Figure 7 a more advanced stage of oolite destruction is shown, and in Figure 8 only scattered remnants of the original oolites can be seen.

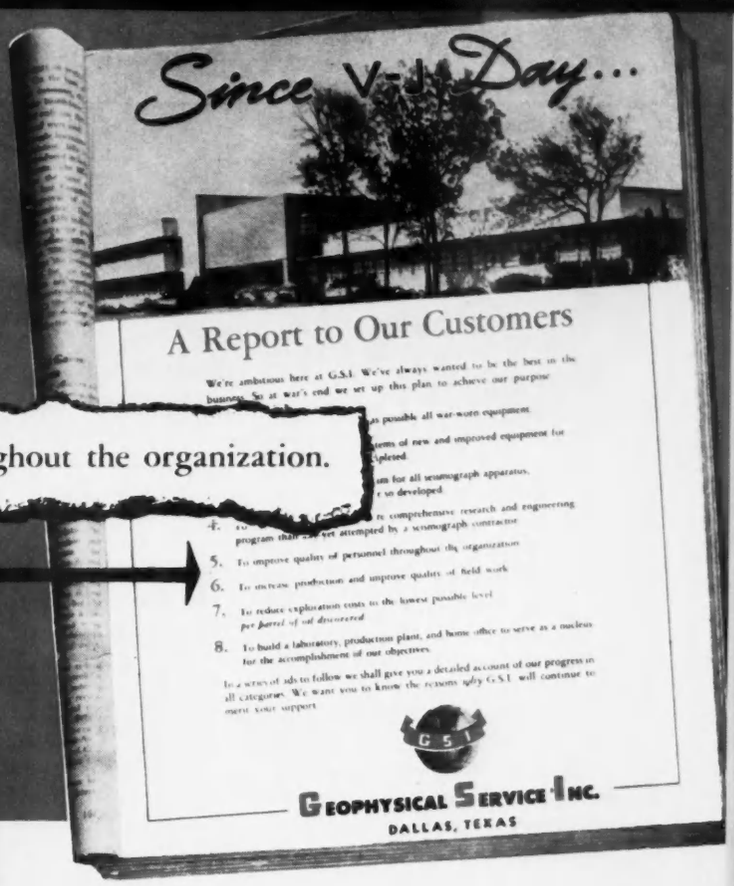
The photographs show clearly several stages in the alteration of an oolitic limestone to a relatively fine-grained limestone in which none of the previous oolitic texture is retained. If this occurred on a large scale, the resulting fine-grained limestone might be interpreted as a chemical precipitate or a quiet-water deposit— entirely erroneous and misleading conclusions.

How many fine-grained limestones are of this type is not known, but some dolomites certainly are altered or replaced limestones. In the Greenbrier limestone of West Virginia, for example, all stages of alteration from slightly sandy, oolitic limestone to slightly sandy dolomite have been observed. The presence of scattered quartz sand grains in many other dolmites suggests that they too were originally slightly sandy, clastic limestones. Certainly, one should wonder as to the hydraulics of transportation and deposition that would permit relatively coarse sand grains to be deposited with fine-grained dolomite. In secondary dolomites, the altering solutions may have been controlled, at least in part, by original porosity, and consequently may have an underlying pattern, which, if worked out, might be very helpful in exploration and development work.

Same Type Centers

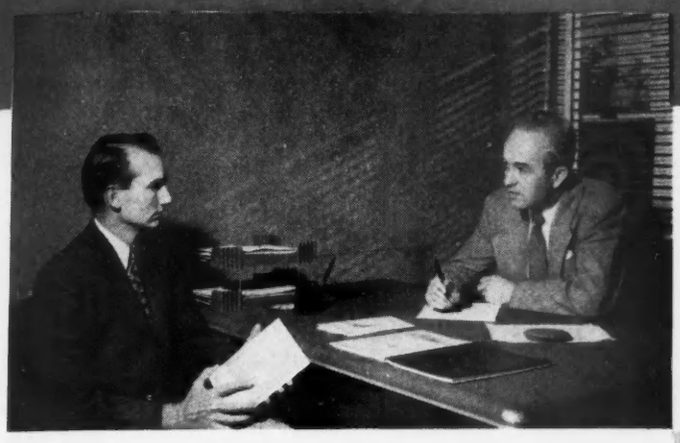
Before leaving Figures 5, 6, and 7, another point should be made. In this limestone all of the oolites have the same type of centers. All of the cores are fine-grained limestone and none are fossils, fossil fragments, or lime sand

Report No. 5


Since V-J Day...
A Report to Our Customers
5. To improve quality of personnel throughout the organization.
6. To increase production and improve quality of field work
7. To reduce exploration costs to the lowest possible level
8. To build a laboratory, production plant, and home office to serve as a nucleus
GEOPHYSICAL SERVICE INC.
DALLAS, TEXAS

5. To improve quality of personnel throughout the organization.

IMPROVING THE QUALITY OF PERSONNEL, TO US AT GSI, MEANS...



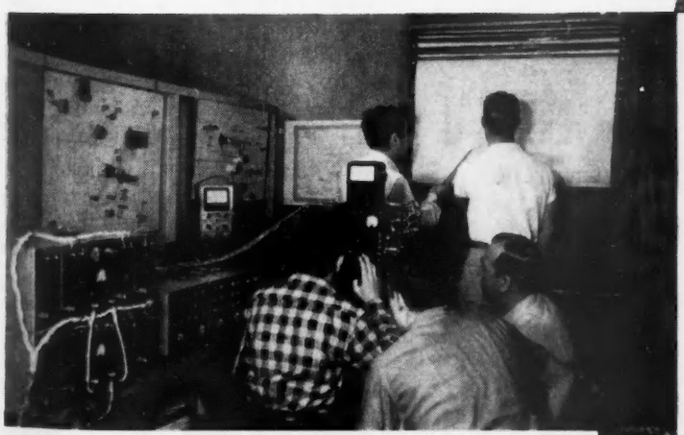
Careful Selection

23 colleges and universities on the North American continent are visited or contacted annually for suitable graduates.

Thorough Indoctrination

100% of new employees receive complete job training and safety instructions.

(Observers, for example, are trained as assistants in the field and are then returned to Dallas for formal instruction courses.)



Refresher Training

In the last two years:

90% of GSI's experienced observers attended refresher classes in Dallas.

50% received GSI correspondence courses on latest field techniques.

10% of our drillers have already returned to Dallas for a recently instituted training course in drill maintenance and operation.

It's the continuance of these policies —year in, year out—that assures you of better seismic service from GSI.

GEOPHYSICAL SERVICE INC

DALLAS, TEXAS

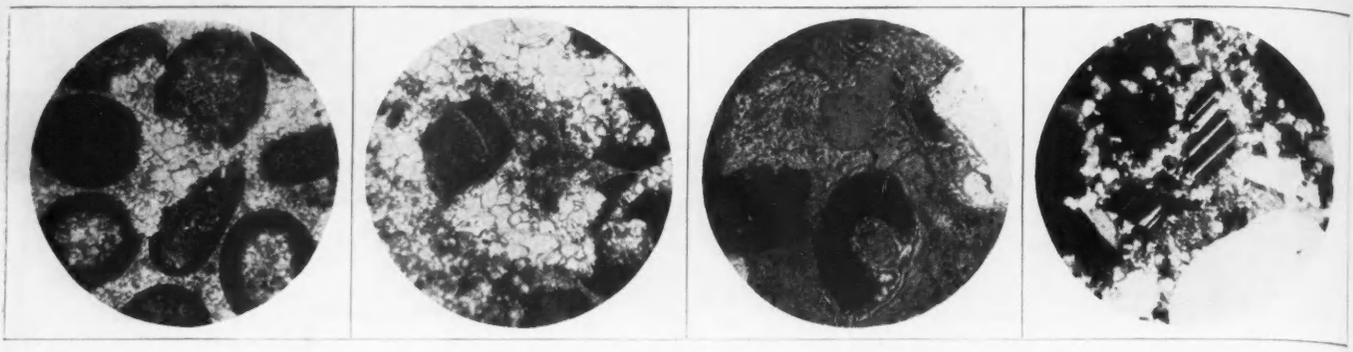


FIGURE 7. FIGURE 8. FIGURE 9. FIGURE 10.

grains. In this respect this limestone differs markedly from that in Figure 2, in which the oolite centers are of many types. Although both rocks would be called oolitic limestones by many geologists, a difference in origin would be suggested to the user of the interpretative method. The oolites in Figure 2 are definitely clastic, but those in Figures 5, 6, and 7 may have developed in place and represent an alteration of a fine-grained lime mud, similar to that observed by Vaughn in samples from the Bahama Banks.

If oolites do develop in several ways, it becomes economically important to distinguish between the primary and secondary types. Rocks made up of the primary, clastic type might have enough original porosity and permeability to make ideal oil or gas reservoirs, whereas rocks containing the secondary type would have low initial permeability and therefore would have no reservoir possibilities unless modified by later solution or fracturing.

Replacement

That carbonate rocks have been changed to dolomites or cherts is recognized by most geologists. That carbonates may replace quartz and feldspar in sedimentary rocks is less commonly appreciated. Figure 9 is a photograph of a sandy dolomite in which the dolomite has partially replaced the quartz sand grains. The contact between the quartz and dolomite are very ragged and irregular, there are deep irregular penetrations of the dolomite into the quartz grains, and at some places rhoms of dolomite penetrate into the quartz grains. Yet in other parts of this rock dolomite merely fills the pores between the original, subangular quartz grains.

If this replacement process was carried out to completion, the original sandstone would be changed to a non-silicious dolomite. How and why the replacement of quartz by carbonate occurs is uncertain. Yet such replacement appears to be relatively common in sedimentary rocks.

Figure 10 is another example of probable replacement. In this photograph a plagioclase feldspar grain in a sandy limestone appears to have been "gnawed" in two by dolomite. The twinning laminae that continue from one half of the grain to the other prove that the two fragments are part of the same feldspar grain. This example is less conclusive than that of the quartz replacement, since it is not possible, at least from what can be seen in the photo, to be certain that the feldspar grain was not irregular in shape, and that the dolomite did not fill an indentation between two prongs of the feldspar grain.

Summary

In this paper it has been attempted to show that describing and naming a rock is not enough. A rock contains many clues that enable one to work out its past history. Features that ordinarily would be considered insignificant may become highly significant when one asks "How was it formed?" or "What does it mean?" Certainly we need to look at sedimentary rocks more critically, and to see what actually is in them, rather than theorizing about what ought to be there. Such an approach should pay handsome dividends.

Most of the examples have been based on what can be seen and deduced from thin sections. The interpretative approach can be applied equally well to the study of outcrops, hand specimens, or drill cuttings, and to other geological problems. By using thin sections, it is hoped that it has been shown how they can help to solve some problems of the geologist and engineer, and thus be more valuable to the petroleum industry in the future than they have been in the past.

About the Author

DR. GORDON RITTENHOUSE received his doctorate from the University of Chicago and also did graduate work at the University of Minnesota. He worked in the Sedimentation division of the Soil Conservation Service from 1935 to 1943 investigating the transportation and deposition of erosional debris by rivers. In 1943 he joined the Fuels section of the U. S. Geological Survey, and in this position was engaged in regional work for the Appalachian Basin Oil and Gas project in working out the sources, distribution, correlation, paleogeography, and sedimentary history of the Paleozoic rocks for the purpose of outlining favorable areas for oil and gas exploration.

In 1946 Rittenhouse joined the University of Cincinnati geological staff but continued part-time work for the Geological Survey until 1947. Since that time he has worked part time as a consulting geologist on sedimentation and sedimentary petrology.

Now Serving CANADA

EDMONTON

SHOOT-N-TEST

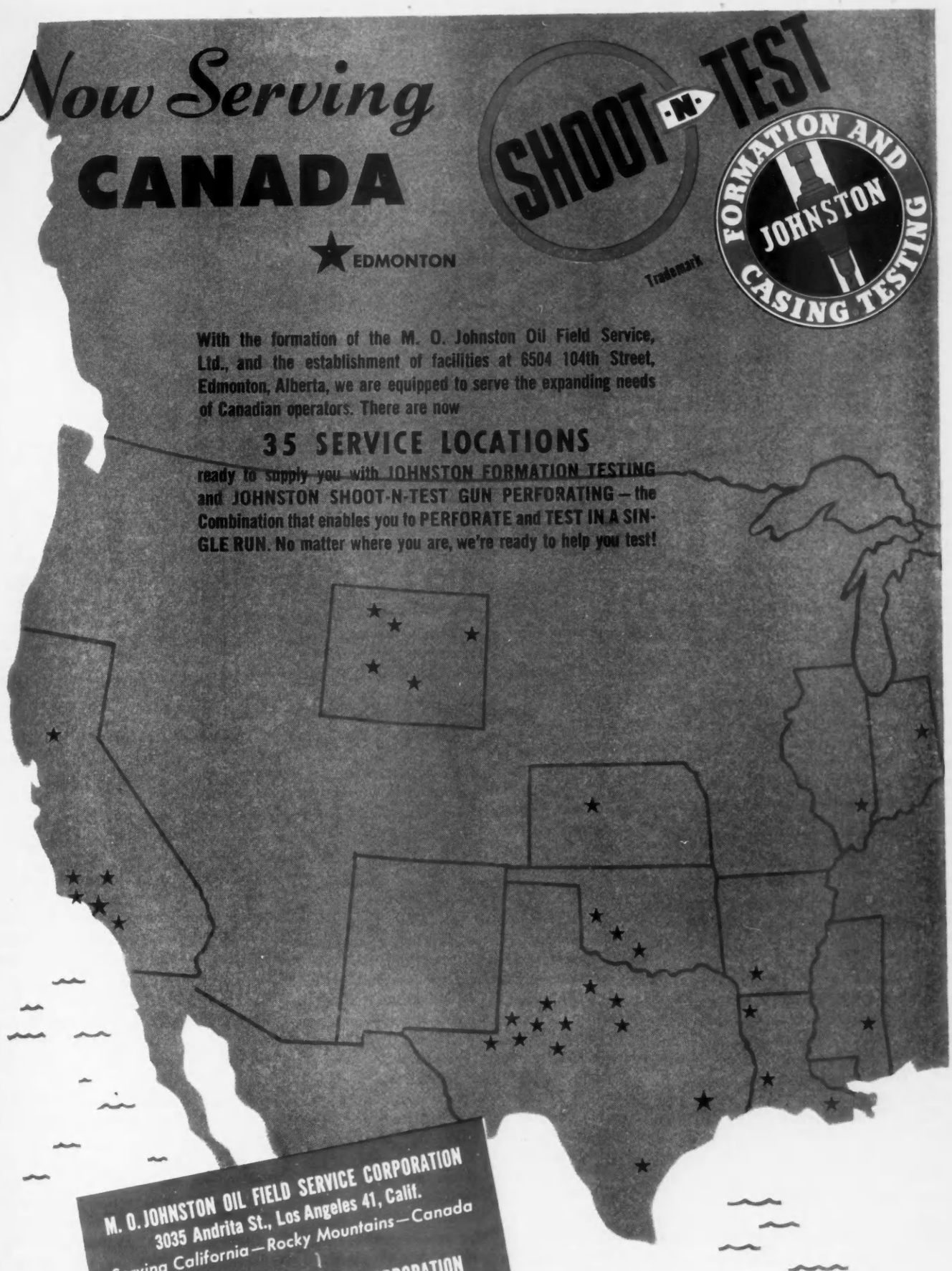
Trademark

FORMATION AND CASING TESTING — JOHNSTON

With the formation of the M. O. Johnston Oil Field Service, Ltd., and the establishment of facilities at 6504 104th Street, Edmonton, Alberta, we are equipped to serve the expanding needs of Canadian operators. There are now

35 SERVICE LOCATIONS

ready to supply you with JOHNSTON FORMATION TESTING and JOHNSTON SHOOT-N-TEST GUN PERFORATING — the Combination that enables you to PERFORATE and TEST IN A SINGLE RUN. No matter where you are, we're ready to help you test!



M. O. JOHNSTON OIL FIELD SERVICE CORPORATION
3035 Andrita St., Los Angeles 41, Calif.
Serving California—Rocky Mountains—Canada

JOHNSTON OIL FIELD SERVICE CORPORATION
5702 Navigation Blvd., Houston, Texas
Serving Mid-Continent—Permian Basin

Geology of the Strake and Squire Field Area, Duval County, Texas

By

GEORGE G. HUFFMAN
Assistant Professor of Geology,
University of Oklahoma

and

ALFRED E. GILES
The Ohio Oil Company

RECENT discovery of new producing horizons in Strake and Squire fields, Duval County, Texas, has prompted a detailed study of sub-surface conditions involving interpretation of electric and drillers logs and construction of structural and isopachous maps and cross sections to scale.

Shales, sandy shales, and complex lenses of sandstone comprise the gently dipping Tertiary formations. These are interrupted by a series of normal faults whose displacement increases progressively with depth. Structural nosing against these faults and changes in their direction afford excellent traps for the accumulation of oil. Production is obtained in the marginal sand belts from fault and stratigraphic traps or a combination of both; producing horizons include the Strake, Squire, Pettus, and Yegua sands of Eocene age. Source beds are probably the darker-colored Jackson and Yegua shales.

By January 1, 1949, 19 producing wells and three dry holes had been completed in Squire field and several locations remained to be drilled. Strake field currently has five pumping and one flowing well. Total cumulative production for the two fields, as of December 1, 1948, includes 731,469 barrels of oil and some gas.

Sub-surface work indicates that further investigation of the marginal sand bodies, based on strand line studies and sedimentology, is justified to locate additional stratigraphic type reservoirs along this trend. It is believed that other isolated sand bodies, such as those producing in Strake and Squire fields will be found.

Introduction

Strake and Squire fields are in the northern portion of Duval County, a part of the extensive South Texas coastal plain. These are accessible by a dirt road running approximately 17 miles northwest of San Diego, Texas.

The topography consists of gently rolling hills of low relief, with surface drainage to the southeast. Mesquite trees are the dominant vegetation, with a thick underbrush of Cinisa, Juajilla, Spanish Dagger, and Cactus. There is sufficient grass to support cattle ranching, the chief occupation of the land owners within the area.

Surficial soils consist of alternate layers of white caliche and reddish sandy soil, with enough top soil to support vegetation. Water for human and livestock consumption is obtained from shallow sands.

History of Petroleum Production

STRAKE FIELD: The discovery well, Strake 1-Yates Ranch, was drilled on a farmout from Stanolind Oil and Gas Company to test the possibility of oil accumulation on postulated fault closure. The well was completed in February, 1943, as a gas well in a stray sand above the Government Wells horizon (Strake sand) and oil in the Yegua. The second well was completed in the Strake sand for 315 barrels of 23.9 gravity oil per day. Operators estimated that Strake 2-Yates would produce 572 barrels of oil per acre foot from 40 acres, a recoverable total of 215,922 barrels. The third, fourth, and fifth wells were dry, encountering salt water on the low side of the producing structure or limited porosity near the margins of the producing sand where ash and silt filled the interstices. Meanwhile, Stanolind had drilled a dry hole limiting the southeastern extent of the field and two producing wells, Welder Estate, 3-A and 5-A. These were edge wells and were producing salt water within a year.

Typical of production from a small sand lens, production declined rapidly and it was necessary to gas lift the oil within a few months. With production limited updip one location by dry gas and one location downdip by salt water, future possibilities seemed none too bright. Strake field was then transferred to Santa Clara and Maguire Industries Inc. Subsequent drilling outlined a narrow, elongated sand body limited on the north by No. 11, on the west by No. 1-B, and on the southwest by No. 8. Recent developments have not been attempted since the limits of the field have been well outlined.

Nine wells were completed in the Strake field. Of these, five were pumping and one flowing as of April, 1948. Total cumulative production to December 1, 1948, was 462,452 barrels with a daily average of 240 barrels.

SQUIRE FIELD: The discovery well, Santa Clara 1-C Welder Estate, was completed in June, 1947, in a thin sand intermediate between the main Government Wells and Strake sands. The new field was named Squire field and the new sand became known as the "Squire sand."

By January 1, 1949, 18 wells had been completed on the east side of the fault which controls production and one gas well on the west. Production is found in the Strake, Squire, Pettus, and Yegua sands with closure on the upthrown (east) side of the fault. Several dry holes mark the probable limits of production in all directions. Four of the above wells have been completed in the Strake sand, seven in the Squire, three in the Pettus, and five in the Yegua. Gas-oil ratios vary from 180:1 to 12,000:1; gravity of

Bandwagon rolling for OIL PROGRESS WEEK!

During the week of October 16th-22nd, your community's attention will be focused on the oil industry! For that's the date of Oil Progress Week—the week that gives you a chance to report the progress you and your industry have made.

Last year, Oil Progress *Day* gave thousands of oil men across the country a great chance to tell their story—and they did, with results that paid off handsomely in good will and good business. This year, with an entire *week* devoted to the event, you've got an even greater opportunity to explain how your firm is helping to provide America with *better*, more efficient oil products ... higher standards of service.

You're the One Who Gains!

YOU gain when your customers understand the competition in oil—the way you compete with rival companies to win customer approval. For as the public learns what a great job you're doing, they'll understand why your business freedom means *more* oil products, *better* oil products, better service for *them!*

Hurry! Get Ready For Your Big Week!

Get free material to promote Oil Progress Week from your local committee office. You can adapt it to fit your needs. Tie in ads ... sample speeches ... booklets ... motion pictures ... employee meeting material ... poster designs ... radio material ... everything you need to make Oil Progress Week *your* week!

Here's how you can benefit from Oil Progress Week

During Oil Progress Week get people acquainted with your business. That way, your neighbors will get a new understanding of the problems you face ... an understanding that's *bound* to result in more friends for YOU! Tell them about today's new and better oil products ... how *hard* you've worked to maintain and step up your high standards of quality and service—and you create good will that pays off for *you* and *your firm* in the long run!

Get in touch with your district committee NOW!

They'll make it easy for you to make the most of Oil Progress Week. They'll give you material you can use to tie your business in with this big nation-wide report!

Get in touch with your local O.I.I.C. office NOW, or write to national office address listed below.

OIL INDUSTRY INFORMATION COMMITTEE
——50 West 50th Street • New York 20, N. Y.——

Don't miss this chance to stand out in your community! Make Oil Progress Week Your Week!

the crude ranges from 25 in the Squire sand to 38 in the Yegua.

Cumulative production to December 1, 1948, is 269,017 barrels; daily production averages over 750 barrels from the 18 wells. Crude flows into a gas separator, then is tanked to await disposal to the Sinclair Refining Company via pipe line.

During the development of Squire field, Maguire Industries transferred its holdings to Camp and Sons of San Antonio. Recently, the Camp interests purchased both the Strake and Squire fields.

Stratigraphy

The Texas Gulf sediments were deposited in an "Open Marginal Basin" with the interior land masses extending through the Edwards Plateau acting as the stable foreland element. The borderland, or unstable land mass existing in the Caribbean area gradually subsided and formed the sedimentary basin which received the clastic material carried from the inland by the streams.

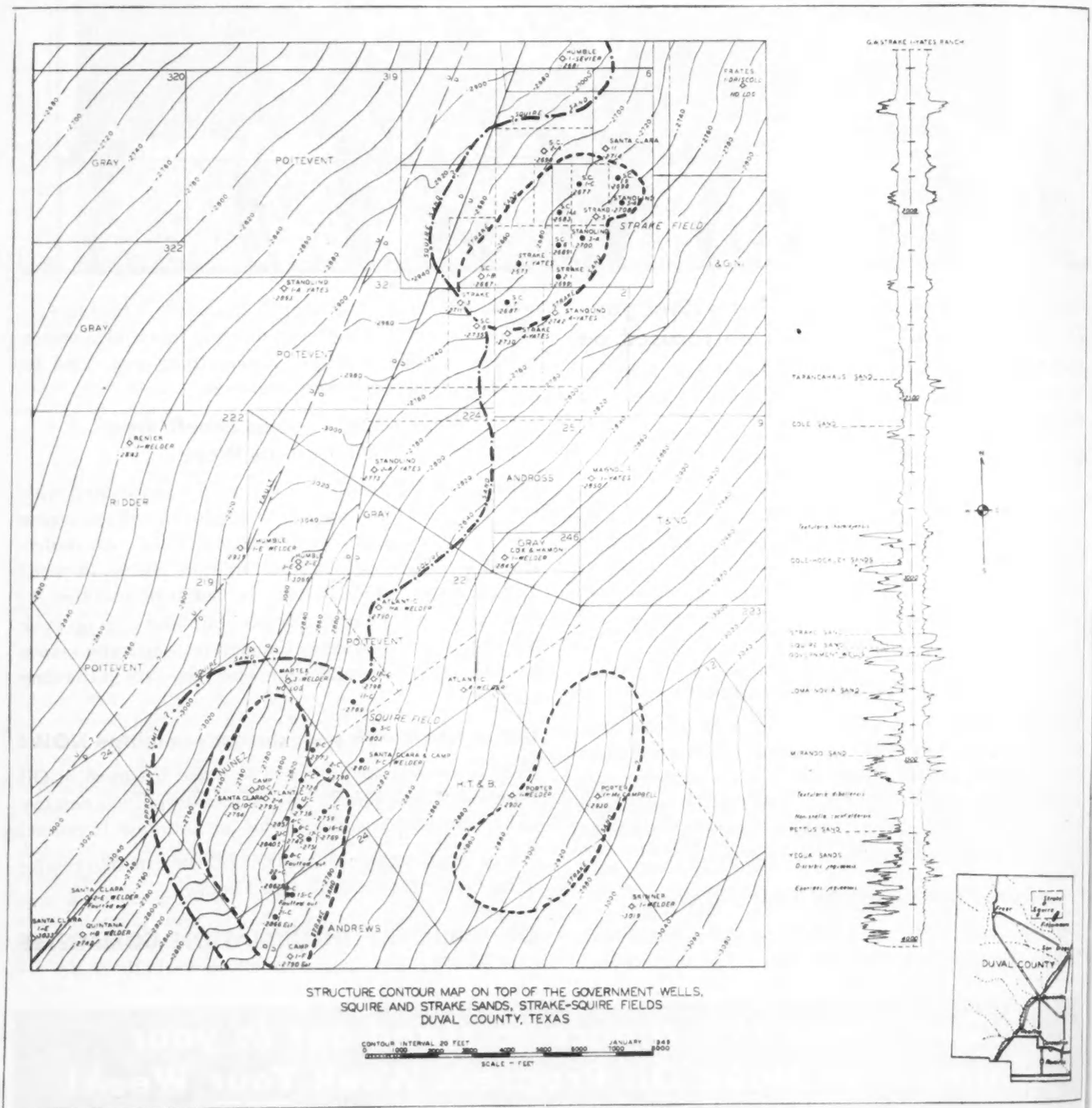
The sediments within this basin comprise shales, sandy shales, and sand wedges which record the repeated transgressions and regressions of the sea as the basin subsided. These range in age from present day beach, deltaic, lagoonal, and marginal marine to possible Jurassic. The nature of the basement complex has not been determined. The formations thicken coastward as they approach the axis of the basin; they thin and change facies toward the land.

The present strike of the formations roughly parallels the present coastline except for occasional variations within the old embayment. Successively older beds outcrop further inland, forming a series of land facing scarps. The Citronelle Group of Pliocene age outcrops in the southeast corner of the Strake-Squire area and the Fleming Group of Pliocene and Miocene age is found at the surface over the remaining area. The deepest formation penetrated in the Strake-Squire area is the Yegua, a portion of the Eocene series.

Eocene Series

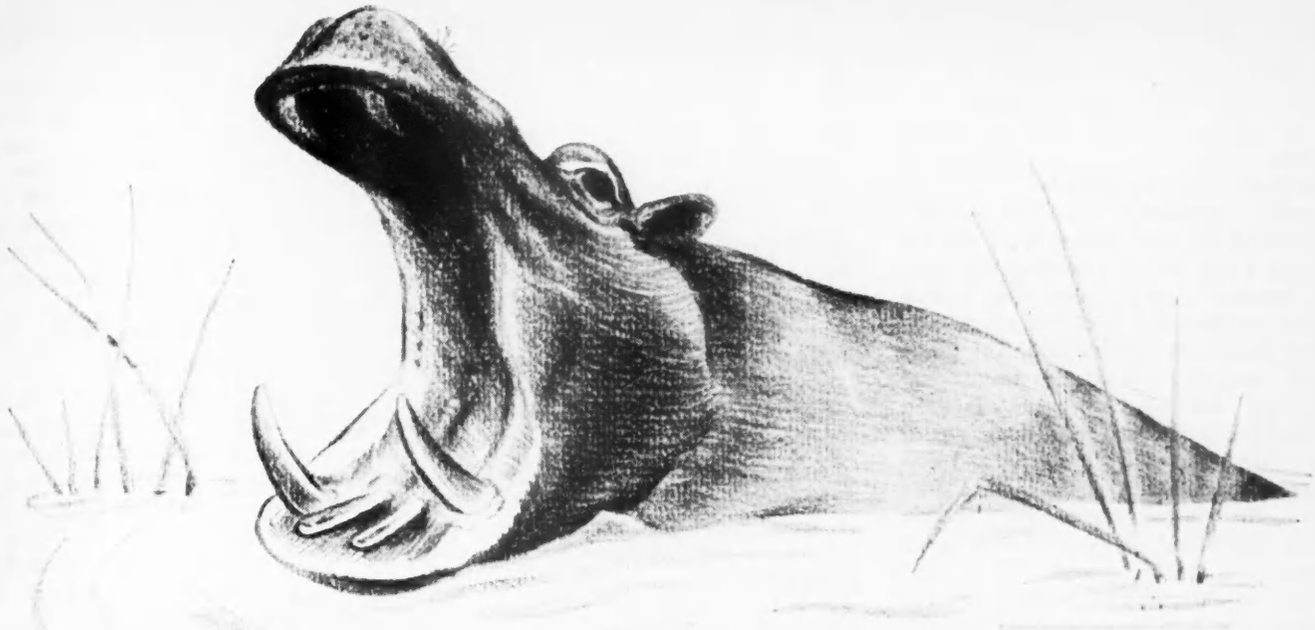
Claiborne Group

YEGUA FORMATION: The Yegua is composed of dark, lignitic shales, sandy shales, and sand. Shell fragments,



STRUCTURE CONTOUR MAP ON TOP OF THE GOVERNMENT WELLS, SQUIRE AND STRAKE SANDS, STRAKE-SQUIRE FIELDS DUVAL COUNTY, TEXAS

FIGURE 1.



MUDDER

Utmost flotation and traction plus the power to hang on when overloaded make the International Diesel Crawler your dependable all-weather tractor. Its instant torque control and advanced-design combustion system give it a performance edge that spells power supremacy in big letters. Centered balance and the great ground contact of wide-gauge tread assure stability and geared-to-the-ground push or pull.

Get the edge on competition with International Crawlers and matched equipment which your International Industrial Power Distributor can supply now.

INTERNATIONAL HARVESTER COMPANY · CHICAGO

Tough, muddy conditions can't stop this International TD-18 Diesel Crawler from turning in a full day's profitable work. Its dependable performance here gives it a high, money-making rating in the records of its owner.

CRAWLER TRACTORS
WHEEL TRACTORS
DIESEL ENGINES
POWER UNITS

INTERNATIONAL HARVESTER

INTERNATIONAL INDUSTRIAL POWER

foraminifera, calcite, selenite, marcasite, pyrite, and fossil plant remains are common.

The Yegua is commonly divided into three members on the basis of foraminifera: a lower member of shady shale and sands containing the index foraminifer *Eponides yeguaensis;* a middle member, considered by many geologists as the top of the Yegua, which resembles the lower but contains *Discorbis yeguaensis;* and an upper member, the Cockfield which contains *Nonionella cockfieldensis.* The Cockfield member, which is transitional between the Claiborne and Jackson groups, is composed of brown shales and sandy shales with lignitic and calcareous materials. Near the top is a gray sand, the Pettus, named from Pettus field, Bee County, Texas where it is an important reservoir rock. This sand forms a well marked anomaly on the electric log and is an excellent marker bed for subsurface mapping throughout the area. It is also an important producer in the Strake-Squire area.

PETTUS SAND: Lithologically, the Pettus is gray, medium to fine-grained sandstone with good porosity. The quartz grains range from angular to subrounded. Associated minerals include biotite, calcite, glauconite, selenite, and calcareous cementing material. Average thickness in Strake-Squire area is 30-35 feet.

Jackson Group

FAYETTE FORMATION: The Jackson group, which forms the upper Eocene, comprises a single formation, the Fayette which is divided into three members, the lower or Cadell, the Middle McElroy, and the Upper Whitsett.

CADELL MEMBER: This includes approximately 100 feet of glauconitic shale containing the index foraminifer, *Textularia dibollensis,* originating the name "Diboll member" in use by many geologists. The abundant glauconite is used as a subsurface marker referred to as the "First Glauconite Zone."

McELROY MEMBER: The McElroy, with a thickness of approximately 700 feet, is important in the South Texas region because it contains a number of marginal marine sands which are important oil producers. The intervening shales are gray to brown in color and are slightly calcareous.

MIRANDO SAND: About 140 feet above the Pettus sand is a 75-foot section of sand known as the Mirando from Mirando field where it is the producing unit. The Mirando is bluish-gray, medium-grained sand with angular to sub-angular quartz grains. It contains lignite and is marked at the top by a prominent lignite bed. The Mirando carries salt water in the Strake-Squire area.

LOMA NOVIA SAND: Separated from the Mirando by 85 feet of shale is a 100-foot section of sand divided by a prominent shale break into an upper and lower Loma Novia. These are similar lithologically to the Mirando and derive their name from Loma Novia field where they are important reservoir rocks. They carry salt water in the Strake-Squire area.

GOVERNMENT WELLS SAND: 70 feet above the Loma Novia and separated from it by sandy shales is the Government Wells sand. Although an extensive producer in Government Wells field where an upper and lower member are present, this sand is not a reservoir rock in the Strake-Squire area. Here only the upper member of 40 feet of gray, medium-grained, calcareous sand is present. Marcasite, pyrite, and traces of lignite occur in the shales above this sand.

SQUIRE SAND: A few feet above the Government Wells is a thin sand which acts as a reservoir rock in Squire field. It is a gray, coarse to fine-grained, porous sand. Sorting is poor with a variety of grain sizes and incorporated biotite and calcite. Thickness varies from zero at the updip pinchout to a maximum of 20 feet downdip where locally it merges with the top of the Government Wells. The strand line trends northeast-southwest, roughly paralleling the present coast, with prominent embayments in the vicinity of Strake and Squire fields.

STRAKE SAND: The Strake sand occurs as isolated lenses separated from the underlying Squire sand by a few feet of shale. The Strake sand varies in thickness from zero to a maximum of 30 feet. The lithology resembles that of the Squire sand. Distribution is limited to isolated bars or lenses associated with the areas of embayment in the Squire strand line.

HOCKLEY OR COLE-HOCKLEY SANDS: These occur about 180 feet above the Government Wells and reach a maximum of 140 feet in thickness. The sands are gray-green to white with a salt and pepper appearance. Minor amounts of selenite, calcite, limonite stain, and mica are present. Although productive updip, these beds carry salt water in the Strake-Squire area. *Textularia hockleyensis* occurs in the shales immediately overlying.

WHITSETT MEMBER: The upper member of the Fayette formation is the Whitsett, a sequence of gray sandy shales and the Cole sand. Thickness approximates 300 feet.

COLE SAND: The Cole sand occurs near the top of the Jackson group. Lithologically it resembles the Hockley sands. It reaches a thickness of 40-50 feet in this area.

The top of the Jackson in sub-surface varies according to the criteria used in its determination. In the absence of the index fossils, *Marginulina cocoaensis* and *Massalina pratti,* the determination is made on the presence of *Discorbis jacksonensis* or by the sudden change of the drilling mud from the greenish Gueydan shales to a gray color in the Jackson.

Oligocene and Miocene Series

Gueydan Group

VICKSBURG (?) OR BASAL FRIO FORMATION: The greenish-gray shales and sands overlying the Jackson are assigned to the Vicksburg on stratigraphic position; typical microfossils which mark the Vicksburg in other localities are absent. One important sand, the Taranchahaus, is assigned to the Vicksburg in this area.

TARANCAHAUS SAND: 30 feet above the top of the Jackson is a 70 foot sand known as the Tarancahaus from the field where it is producing. Lithologically it resembles the Cole sand.

The Economic Bureau of Geology at the University of Texas recognizes an unconformity between the Jackson and Gueydan groups.

FRIO AND CATAHOULA FORMATIONS: The Frio and Catahoula are lithologically similar and difficult to differentiate in subsurface; since they are largely continental in origin, subdivision is not vital in petroleum work in this area. The marine Anahuac formation, which separates these in the downdip section, is not present in the Strake and Squire fields.

The lithology of the undifferentiated Frio and Catahoula is chiefly of multicolored shales, varying from buff to reddish-green. Volcanic ash, volcanic glass, bentonite, and calcareous material are common. The Catahoula-Frio sequence is bounded above and below by unconformity.

Miocene and Pliocene Series

Fleming Group

OAKVILLE AND LAGARTO FORMATIONS: The base of the Fleming group is marked by the water-bearing sands of the Oakville. Overlying beds include red, grey, brown, and buff shales, sandy shales, yellow clays, and mottled sandstones. Combined thickness of the Fleming group is approximately 400 feet; these beds are seldom logged because surface casing is usually set near the base of the Oakville.

Recent Deposits

The surface is covered by alternating layers of caliche and clays of questionable age. Present deposition is limited to valley fills of sand, gravel, and detrital caliche and clay. Inasmuch as erosion is

It's true, not just any man may subscribe to WORLD OIL. Subscriptions are limited to oil men who are engaged in: 1—operating phases of oil and gas exploration, drilling, producing and pipe line; or 2—manufacturing and distribution of oil field and pipe line equipment.

WHY SUCH A SELECTIVE POLICY?

To print and mail a year's subscription of WORLD OIL costs approximately six times the $2.00 we receive for it. Advertisers offering their products for sale through WORLD OIL make up the difference. They need to reach only those oil men who buy or influence the buying of equipment, and our advertising rates are based on this circulation.

The average manufacturer, for example, will not willingly or knowingly pay an advertising rate based upon circulation which includes a considerable number of royalty or stock owners. This is no reflection upon this group of oil men or their connection with the industry. Such subscriptions would greatly increase the cost of the manufacturer's advertising while providing him no additional sales prospects for his equipment. The advertising in these pages is bought on the basis of number of subscribers engaged in operating phases. The success of WORLD OIL therefore demands that subscriptions be limited.

Under this policy, we return a large number of subscriptions annually. Some years rejects have run well in excess of 1000, and if we did not have this policy we could have several thousand more subscriptions.

WORLD OIL is written to interest only those oil men engaged in looking for oil, drilling for it, getting it out of the ground, and transporting it by pipe line. More than 20,000 subscribers now read WORLD OIL every month—making up the largest circulation in the 32-year history of this magazine. It's growing every month, too.

WORLD OIL

ESTABLISHED 1916
AS THE OIL WEEKLY

THE PETROLEUM PUBLICATION SPECIALIZED FOR

Exploration, Drilling, Production, Pipe Line Operations & Management

progressing slowly on this little dissected coastal plain, recent deposits are not extensive.

Structure

The general structure, as depicted by sub-surface studies, comprises a complex system of faulting superimposed upon a series of formations which dip uniformly toward the coast. Since these formations thicken toward the Gulf of Mexico, the dip on older beds increases progressively with depth.

Faulting is largely of the tensional type, caused by stresses imposed on the strata when the basin subsided and the interior masses acted as the resisting force or stable element. Locally, "up-to-the-coast" faults are most common with the throw increasing with depth; the occurrence of major faults downthrown to the coast are known adjacent to the area. A small graben is postulated west of the Strake and Squire fields. Some of the faults terminate abruptly in one direction while they steadily increase their throw in the opposite direction; branching of fault trends is indicated where the Squire field fault intersects the main northeast-southwest fault north of Squire field.

Prominent structural nosings are revealed by detailed contour mapping; where these are intersected by faulting, closure is afforded. Other faults bend sharply toward the coast, creating structural traps in the reentrant of the upthrown side. Additional accumulation occurs in stratigraphic traps formed by updip pinchouts of lensing sand units.

A composite structural contour map has been drawn to depict the relations which exist among the Government Wells, Squire, and Strake sands (Figure 1). Datum changes are made at the margin of each sand to show distribution and behavior. The regional dip on the Government Wells sand is approximately 120-130 feet per mile, increasing eastward where top members grade into shale. The overlying Squire sand thins from a maximum of 20 feet to zero along the updip margin. The strand line trends northeast-southwest with prominent embayments in the vicinity of Strake and Squire fields where closure is afforded. A 25 foot datum change is maintained where contouring changes from the underlying Government Wells to the Squire sand.

Isopachous studies indicate the limited distribution of the Strake sand which occurs only as isolated lenses that shale out in all directions. Two main bodies have been identified, one in Strake field, the other in Squire. A third is postulated in the vicinity of Porter 1-McCampbell, Survey 12. A maximum development of 30 feet is found in Strake 1-Yates and Atlantic 2-A Welder Estate. Lateral extent is defined by lack of anomoly on electric logs and core records which record the passage into shale. Dip and attitude conform to that of surrounding lithologic units.

The major controlling fault is a large, northeast-southwest trending fault upthrown toward the east. Although surface expression has not been established, the trend and displacement are controlled by abundant subsurface information. The fault is of the normal type, dipping westward at approximately 60 degrees. The throw increases from 220 feet in the northeast corner of the area to over 350 in the southwest. The fault is defined by the following cut sections: Humble 1-Sevier, 220 feet @ -1150; Strake 3-Yates, 230 feet @ -1287; Stanolind 2-A Yates, 230 feet @ -1610; Santa Clara 10-C Welder, 320 feet @ -842; Santa Clara 2-E Welder, 320 feet @ -2918; and Santa Clara 1-E Welder, 350 feet @ -4000 feet. There are minor changes in trend of this fault, the most prominent is north of Strake field in Stanolind 1-Driscoll where the fault bends abruptly southward.

A second fault is responsible for much of the production in Squire field, where closure is afforded on the upthrown side of a normal "up-to-the-coast" fault with a throw of 130 feet. The fault plane dips westward at 60 degrees, the trend is north-south, and the displacement decreases northward where this fault intersects the larger fault described above.

The presence of a small "down-to-the-coast" fault west of the main fault is supported by small cut sections in wells adjacent to this area. Humble 3-Welder is structurally low and is believed to occupy a position within the small graben thus produced.

Occurrence of Oil and Gas

Strake Field

Strake field is producing from a stratigraphic type oil reservoir. The fault west of the field is not involved in the accumulation of oil in the main producing horizon, the Strake sand.

The Strake sand occurs as an elongate lens or bar; the entire sand belt is less than one-half mile in width. The maximum thickness of 30 feet is developed in Strake 1-Yates Ranch, discovery well. Tilting has resulted in the accumulation of oil in the northwest portion of the bar. Presence of ash and silt in the interstices and lateral passage into shale have decreased the porosity so that the edge wells are not productive.

Some oil and gas-distillate have been recovered from irregular stringers of sand in the Yegua horizon in the discovery well. The Squire sand, which is present in Strake field, thins to zero west of the field. Remaining sands maintain their thickness and dip across the field, shaling out gradually toward the east.

Squire Field

Production in Squire field is the result of combined fault and stratigraphic trap type oil reservoir. The controlling fault is a small, north-south trending branch of the larger fault to the southwest. Structural nosing against this fault is responsible for most of the production.

The Strake sand forms an isolated lens. The fault passes through this lens, leaving a small portion on the upthrown side where it produces oil and a larger on the downthrown side where it is gas bearing. The Strake sand produces 25-26 gravity oil.

The Squire sand is more widespread and terminates west of the field where its strand line forms a prominent embayment. The Squire sand likewise produces oil on the upthrown (east) side of the fault and gas on the downthrown. Santa Clara 10-C Welder tested gas in both the Strake and Squire sands. Oil from the Squire sand ranges from 25 to 27 gravity, suggesting a common source with that in the Strake sand.

Lower horizons, Pettus and Yegua, produce oil on the upthrown side where structural nosing against the fault gives 35-40 feet of closure. Oil from the Pettus has a gravity of 36, while that of the deeper Yegua is 38.

Future Possibilities

Present development in the Strake-Squire area consists primarily of drilling several proven locations within present field limits. A recent wildcat, Renick 1-Welder, Survey 222, west of Squire field failed to find oil in commercial quantities.

Future tests will probably be drilled in the area to find additional faulting and stratigraphic traps such as those currently producing.

The most interesting feature is the isolated nature of the Strake sand lenses and their relation to the embayed and irregular strand line of the Squire sand. This belt of marginal marine sand which continues beyond the Strake-Squire area offers future possibilities in strand line and sand lens production. A detailed study of this relationship will lead to a better understanding of the nature of these "stray" sands and will increase the possibility of locating future stratigraphic type oil reservoirs along this trend.

ACKNOWLEDGMENT

The writers wish to thank Guy E. Green, Santa Clara Oil Company, who furnished information and production data on Strake and Squire fields; George W. Strake, Houston, who supplied pertinent material on Strake field; B. G. Martin, Gulf Oil Corporation, and S. A. Berthiaume, The Texas Company, who furnished electric logs; and other geologists and companies who gave valuable advice.

Electric logs were not available on several wells in Squire field; data on these wells were secured from driller's logs and core records furnished by the State Well Log Service, Austin, Texas. The Texas Railroad Commission furnished production figures.

1,250,000 miles... .0012¢ per mile

transmission maintenance

Listen to what T. N. Busch, assistant superintendent, Woodlands Dept., International Paper Company, Georgetown, S. C., has to say about Fuller's economic contribution to the largest single paper mill in the world . . . producers of 1,350 tons of board per day. Mr. Busch says:

"We are using 10 Fuller Transmissions in our diesel trucks which have traveled a total of 1,250,000 miles. Our maintenance costs for these ten units amount to a total of $150.00. We are very much satisfied with this performance, particularly as the trucks are used under extremely heavy service involving on and off the road hauls of pulpwood."

Kraft paper and board mills have made a very great contribution to the economic welfare of the South . . . Fuller Transmissions have made a similar contribution to the largest of these mills, the International Paper Company.

Fuller Transmissions and Auxiliaries are built for long wear-life . . . for maximum road service without costly, time-consuming overhauls. In addition, Fuller Transmissions offer the advantages of easy shifts and quiet operation. That's why fleet owners specify Fuller.

FULLER MANUFACTURING COMPANY (Transmission Division), KALAMAZOO 13F, MICHIGAN

Unit Drop Forge Division, Milwaukee 1, Wis. • WESTERN DISTRICT OFFICE (SALES & SERVICE—BOTH DIVISIONS), 1060 E. 11th Street, Oakland 6, Calif.

Exploration

12 Percent Above 1948 Period

By CECIL SMITH, Statistical Editor

ATTENTION was again attracted to the search for oil on the tidelands during August as two wildcat oilers were completed off Louisiana and the first production of any kind for the Texas side of the Gulf's open waters was found with a gas-distillate producer.

Kerr-McGee Oil Industries, Inc., veteran tidelands operator, with Phillips Petroleum Company made an oil strike 2½ miles off the Cameron Parish shore in southern Louisiana. State 1 was completed flowing 934 barrels of 42.3-gravity oil a day through 14/64-inch choke. Production came through perforations at 10,390 to 10,408 feet opposite a sand of Miocene age.

Louisiana's second off-shore discovery for the month was made by Barnsdall Oil Company at Breton-State 5, in Block 32, Plaquemines Parish. Initial output was 187 barrels of 25.1-gravity oil a day through 14/64-inch choke and came from the interval 5802-04 feet.

While not included in August's finds, a later tidelands discovery was made by Stanolind Oil & Gas Company off Cameron Parish, Louisiana. The State Lease 1137 No. 2-A on a late test flowed 912 barrels of 34.9-gravity oil per day through a one-fourth-inch choke. Pro-

Summary of Results of Exploratory Drilling

ITEM	Aug., 1949	July, 1949	Eight Months January-August 1949	1948	Percent Dif.
Oil Discoveries	89	91	674	580	+ 16.2
New Fields	66	70	467	389	+ 20.1
New Pays	23	21	207	191	+ 8.4
Distillate Discoveries	8	11	96	64	+ 77.8
New Fields	8	5	51	35	+ 45.7
New Pays		6	45	29	+ 55.2
Gas Discoveries	12	12	93	90	+ 3.3
New Fields	8	11	75	66	+ 13.6
New Pays	4	1	18	24	− 25.0
Total Discoveries	109	114	863	734	+ 17.6
Extensions to Fields	21	19	173	133	+ 30.1
Oil Fields	20	18	156	111	+ 40.5
Distillate Fields	1		11	8	+ 37.5
Gas Fields		1	6	14	− 57.1
Total Prod. Tests	130	133	1036	867	+ 19.5
Dry Holes	512	529	3872	3513	+ 10.2
Wildcats	503	518	3818	3465	+ 10.2
New Pays		5	7	7	
Outposts	9	6	47	41	+ 14.6
Total Expl'tory Tests	642	662	4908	4380	+ 12.1
Percent Productive	20.2	20.1	21.1	19.8	
Percent Dry	79.8	79.9	78.9	80.2	

Results of Exploratory Drilling in August and First 8 Months, 1949-1948, By Districts

State or District	MONTH OF AUGUST, 1949													FIRST EIGHT MONTHS, 1949																	
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests								Unproductive Tests					Total Exploratory Tests	
	New Fields			New Pays			Extensions								New Fields			New Pays			Extensions									
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	8 Mo. 1949	8 Mo. 1948	Wildcats	New Pays	Outposts	Total Dry 8 Mo. 1949	Total Dry 8 Mo. 1948	8 Mo. 1949	8 Mo. 1948
Alabama																										10			10	13	10	13
Arizona																										4			4	1	4	1
Arkansas				2						2	15			17	5		1	5			1			12	4	49	1	2	52	69	64	73
California											37		1	38	8		2	8			11		2	31	37	228	3	2	233	152	264	189
Colorado	1									1	8			6	1									1	2	28		1	29	35	30	37
Florida											1			1												10			10	16	10	16
Georgia																										4			4	3	4	3
Illinois	1			6			6			13	65			78	14			24			34			72	67	373			373	333	445	400
Indiana	7									7	23			30	33			3			4			40	31	255			255	156	295	187
Kansas	14						1			15	27			42	54		4	4			6			68	51	256			256	311	324	362
Kentucky	2						1			3	4			7	9						2			11	7	30			30	35	41	42
Louisiana	4	2		1			1			8	20			28	21	12	4	22	13	1	5	1		79	82	157			157	153	236	235
North Louisiana							1			1	15			16	5	4	1	1	7		1			19	15	86			86	77	105	92
South Louisiana	4	2		1						7	5			12	16	8	3	21	6	1	4	1		60	67	71			71	76	131	143
Maryland																														1		1
Michigan	1									1	20			21	13		1				5			19	14	195		1	196	161	215	175
Mississippi											12		1	13	4			2						6	4	76		3	79	67	85	71
Missouri																										5			5	11	5	11
Montana			1							1	3			4	3	1	1				1			6	4	21		1	22	21	28	25
Nebraska											2			2	1									1		4			4		5	
New Mexico	1		2	1						4	4		1	9	9		2	4					1	15	14	34		1	35	44	50	58
Ohio											4			4							2		1	3	10	25			25	25	28	35
Oklahoma	6	1	1	5		1	1			15	44			59	39	3	5	15	1	3	17			83	78	301			301	320	384	398
Pennsylvania			1							1				1			2							1		1			1	3	3	3
South Dakota																										2			2	1	2	1
Tennessee															1									1	1	10			10	21	11	22
Texas	26	5	2	8		3	10	1		55	201		4	260	240	35	47	111	31	14	62	10	3	553	427	1650	3	31	1684	1497	2237	1924
Dist. 1 S. Central	4									4	20		1	25	13			1			1			15	5	158		2	160	122	175	127
Dist. 2 Middle Gulf	2	2				1		1		6	15		1	22	6	14	7	5	8	4	1	4	1	50	48	108		5	113	129	163	177
Dist. 3 Upper Gulf	1	1		2						4	23			27	15	11	5	36	11	2	4	3		87	70	166			166	172	253	242
Dist. 4 L. Gulf-SW	2	2	1	4		1	1			11	21			32	11	7	14	32	10	7	2	1		84	65	233	1	6	240	231	324	296
Dist. 5 E. Central											7			7	2	1						1		4	7	50			50	55	54	62
Dist. 6 Northeast	1									1	8			9	7	2	2	1	2			1	1	16	14	48	1		49	44	65	58
Dist. 7-B N. Central	7			1		1				9	49		1	59	84		12	15		1	5			117	83	378	1	3	382	269	499	352
Dist. 7-C W. Central	2			1			2			5	11			16	12		3	4			8			27	16	66		2	68	67	95	83
Dist. 8 West							6			6	13		1	20	25			5			28		1	59	64	124		4	128	117	187	181
Dist. 9 North	7		1				1			9	34			43	64		4	12			13			93	55	315		9	324	288	417	343
Dist. 10 Panhandle															1									1		4			4	3	5	3
Utah											3		1	4	2						1			3	3	11		1	12	12	15	15
Virginia																									1						1
Washington																													2		2
West Virginia			1							1	1			2			6							6	3	2			2	2	8	5
Wyoming	3									3	12		1	16	10			9			5			24	27	77		4	81	48	105	75
Total U. S.	66	8	8	23		4	20	1		130	503		9	642	467	51	75	207	45	18	156	11	6	1036	867	3818	7	47	3872	3513	4908	4380

Are Your INSURANCE COSTS... *...too high?*

COMPLETE SERVICE

The Texas Employers' Insurance Association maintains facilities whereby employers of labor in Texas can secure complete and highly specialized Workmen's Compensation Insurance Service, including:

- Nineteen district service offices.
- Proved financial responsibility.
- Qualified rating and underwriting "know-how."
- Prompt handling of claims.
- Texas' largest insurance safety engineering organization.
- Insurance at cost to Texas employers.

Do Workmen's Compensation Insurance costs make up a substantial part of your rising operating costs? They do? Then how would you like to reduce your operating costs by reducing your Workmen's Compensation Insurance costs? Thousands of business and industrial firms operating in Texas have effected such reductions and improved their Workmen's Compensation Insurance service at the same time.

How? By placing their Workmen's Compensation Insurance with the Texas Employers' Insurance Association. The Association's thirty-five years' specialization in this one line of insurance and its statewide service facilities enable it to render the best possible service and still effect substantial savings. These savings are returned to policyholders in the form of annual dividends and guaranteed cost discounts. Total savings to date exceed $23,000,000.

Why don't you take advantage of the service and savings offered by the Association?

TEXAS EMPLOYERS INSURANCE ASSOCIATION

Home Office: DALLAS • *District Offices in:* ABILENE • AMARILLO • AUSTIN • BEAUMONT • CORPUS CHRISTI • DALLAS • EL PASO • FORT WORTH GALVESTON • HARLINGEN • HOUSTON • LUBBOCK • MIDLAND • PORT ARTHUR • SAN ANTONIO • SHERMAN • TYLER • WACO • WICHITA FALLS

HOMER R. MITCHELL, *Chairman of the Board* A. F. ALLEN, *President*

duction was from Miocene at 8823-28 feet.

Stanolind was the first to find production of any kind on Texas' tidelands although it was gas-distillate instead of crude. The operation was made jointly with The Ohio Oil Company and Melben Oil Company. The successful well, State 1, off Galveston Island, gauged slightly more than 5 million cubic feet and 48 barrels of 54.6-gravity distillate daily through one-fourth-inch choke.

Wildcat drilling in general eased slightly during August, but it was kept at a fairly high level. Exploratory well completions totaled 642 to fall behind the average of 667 for the previous five months and the 664 finaled in August, 1948. Yet the year's eight-month total of 4908 continued to hold a lead of more than 12 percent over the 4380 tests made in last year's eight months.

Eighty-nine oil fields were opened during August compared with 91 in July and only 78 in August a year ago. New oil horizons in existing fields numbered 23 to top July's 21 and last August's 10. In all, 112 new crude sources were credited to August, the same as in July, and considerably more than the 88 new pools added in August a year ago.

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in August, 1949

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		ARKANSAS—New Oil Pays						
Nevada	Stephens, N.	H. T. Pannell's Bannister 1, C SE SE NE 1-15s-20w	8-12-49	4012	2932- 2938	L Glen Rose sd; L Cre	P 240; 48 wtr	28
Union	Hillsboro	Dorsett Co. & R. H. Crow Tr's Union Saw Mill 101, (OWWO), C NE SW NE 11-18s-14w.	8-10-49	4010	3938- 3945	Travis Peak sd; L Cre	F 329; 67 wtr 1/4"	34
		COLORADO—New Oil Field						
Routt	Oak Creek	R. E. Havenstrite's Ryles 2, NW SW NE 2-3n-86w, 20 mi se Steamboat Springs.	8-26-49	6747	6640- 6747	L Morrison sd; Jur	P 300	37.9
		ILLINOIS—New Oil Field						
Bond	Beaver Creek, N.	Hoiles Petroleum Co's Hoiles 1, 400 fr wl 330 fr sl SW SW 13-4n-3w, 2½ mi nw Beaver Creek pl.	8- 9-49	1127	1121- 1124	Bethel sd; Miss	P 3; 10 wtr	....
		ILLINOIS—New Oil Pays						
Franklin	Sesser	Paul Moseback's Bays 1, 445 fr sl 298 fr el NE SW 35-5s-1e	8- 9-49	4500	4360- 4435	Devonian li; Devo	P 35	....
Franklin	Whittington, W.	B. P. Jones' Boyles 1, 330 fr nl 230 fr wl SW 13-5s-2e, ½ mi fr prod	8- 9-49	2780	2616- 2625	Bethel sd; Miss	P 25	....
Gallatin	Inman, Cent.	J. L. Crawford's Sutton 1, SW SW NE 6-8s-10e	8- 9-49	2496	2123- 2131	Tar Springs sd; Miss	P 18; 32 wtr	....
Gallatin	Inman, Cent.	J. L. Crawford's Wilson 2, NE SE NW 6-8s-10e	8-23-49	2820	2772- 2779	L Renault li; Miss	P 12	....
Jefferson	Williams	W. F. Seizler's Wakefield 1-A, 430 fr sl 330 fr el NE 3-3s-2e	8-30-49	2585	2504- 2509	Bethel sd; Miss	P 18; 18 wtr	....
White	New Harmony, S.	V. T. Drilling Co's E. Brown 1, SE NW NW 29-5s-14w, ½ mi w of prod	8-30-49	3136	3005- 3012	Aux Vases sd; Miss	P 35	....
		ILLINOIS—Oil Field Extensions						
Clark	Weaver	W. W. Dayton's C. A. Cox 1, NE NE NE 30-11n-10w, ¾ mi sw extension	8-16-49	2060	2029- 2060	Devonian li; Devo	P 187	....
Gallatin	Inman, E. Cons.	Carter Oil Co's C. L. Hughes 1, SE SE NE 8-8s-10e, 1¼ mi w extension	8-23-49	2936	2717- 2721	Aux Vases sd; Miss	P 20; 50 wtr	....
Gallatin	Junction, N.	Oil Management Co. & Hanes Drlg Co's Max Wilson 1, NE NE NW 2-9s-9e, ¾ mi e extension.	8-30-49	2945	1600- 1615	Pennsylvania sd; Penn	P 32; 15 wtr	....
Wabash	Maud, N. Cons.	Oil Management Co. & Hayes Drlg. Co's G. Woods 1, NE NE SE 31-1n-13w, 1 mi n extension.	8-23-49	2889	2787- 2792	L O'Hara li; Miss	P 20; 70 wtr	....
Wabash	New Harmony-Keensburg Cons.	E. Brown's Dunn 1, SE SE SE 26-2s-14w, ½ mi extension	8-16-49	2568	2544- 2560	Cypress sd; Miss	P 12	....
Wayne	Zenith, S.	Russell P. Johnson's Edward Vest 1, NE NW SW 16-1n-5e, ¾ mi s ext.	8-23-49	3004	2999- 3003	McClosky li; Miss	P 256	....
		INDIANA—New Oil Fields						
Gibson		Evans-Dobbs-S. Lewis & Sons' A. C. Brown 1, NE NW NE 28-2s-11w, 2 mi e Owensville, N pl.	8-23-49	2150	2112- 2134	Benoist sd; U Miss	P 100	....
Knox		Wm. P. Muller's Maud Simpson 1-A, SW NW SW 14-1n-10w, 1 mi n Hazelton pl.	8-25-49	1847	1770- 1775	Rosiclare li; Miss	P 45	....
Posey	Crunk, S.	George & Wrather-Aurora Gasoline Co.-Barclay Oil Co's L. Tenison 1, NW SW NW 20-7s-12w, 1½ mi e LaMott pl.	8- 4-49	2077	2070- 2077	Hardinsburg sd; Miss	P 20	....
Posey		Chas. C. Clark's Sugg Heirs 1, SW SE SE 21-6s-14w, btw Welborn & Grafton pls.	8-16-49	2516	2500- 2506	Cypress sd; Miss	P 10	....
Sullivan	Paxton	Arthur J. Nash's Ruben H. Johnson 1, NE SW SE 23-7n-9w	8- -49	1207	1200- 1207	Rosiclare li; Miss	P 10	....
Sullivan	York Ferry	A. J. Slagter & Frank Strickland's Kelley 1-A, 370 fr wl 330 fr nl NW NW SE 11-8n-11w.	8- -49	606	580- 606	Pennsylvania sd; Penn	P 22	....
Vanderburgh		Ryan & Sharp's Geo. Schweikart 1, NE NE NW 15-5s-11w, 2 mi sw Darmstadt pl.	8-23-49	2650	2536- 2542	O'Hara li; L Miss	P 151	....
		KANSAS—New Oil Fields						
Barton	Meadowside	Eldorado Refg Co.-Flourney & Williams Drlg Co's Stumps 1-B, NW NW SE 24-18s-11w, 2 mi e Ames pl.	8- 2-49	3299	3284- 3299	Arbuckle li; Ord	Sw 960	....
Butler		D. S. Hager et al's Reiserer 1, SW SW NW 15-26s-7e, 1½ mi n Young pl	8-23-49	3176	3161- 3176	Viola li; Ord	P 25	....
Cowley	Stayton	K. T. Wiedemann's Stayton 1, SW SW NW 32-32s-4e, 3 mi sw State pl	8-23-49	3141	2123- 3138	Bartlesville sd; Penn	P 20	41
Ellis	Dreiling	M. B. Armer's Dreling 1, SE SE NE 21-14s-16w, 6 mi se Herzog pl	8- 9-49	3383	3366- 3383	Arbuckle li; Ord	P 173	....
Ellis		W. L. Hartman & Jack Hinkle's Reed 1, NW NW SE 5-13s-17w, 1 mi w Catherine, NW pl.	8-26-49	3621	3424- 3436	Lansing-K.C. li; Penn	P 47	....
Graham	Muilenberg	D. G. Hansen's Muilenberg 1, SE NE SE 1-10s-21w, 1 mi w Palco pl	8-29-49	3842	3839- 3842	Arbuckle li; Ord	P 155	....
McPherson	Bonaville	Texas Pacific C&O Co's Gabrielson 1, SE SW NW 33-17s-2w, 3 mi nw Twin Mounds pl.	8- 9-49	3570	3557- 3570	Simpson li; Ord	P 108	29.6
Pawnee		Jayhawk Drlg. Co. & Vickers Pet. Co's Dirks 1, NE NE SW 23-20s-16w, ¾ mi w Pawnee Rock pl.	8-25-49	3775	3763- 3775	Arbuckle li; Ord	F 203	....
Phillips		L. B. Stableford & B&R Drlg Co's Huffstutter 1, NE NE NE 6-2s-18w, 2 mi ne Dayton, N pl.	8-23-49	3480	3407- 3435	Lansing-K.C. li; Penn	P 58	....
Rice		Tom Allan's Stahl 1, CSL NW 14-20s-8w, 1½ mi s Lyons gas pl	8-23-49	3332	3310- 3325	Misener sd; Miss	P 25	....
Russell		Eldorado Rfg Co's Ely 1, NE NE NE 15-15s-13w, 1 mi e Trapp pl	8-16-49	3319	2948- 2952	Dodge li; Penn	P 89	....
Russell		R. H. Shields & Anschutz 1, NW SW SW 25-13s-14w, 1½ mi e Russell pl	8- 2-49	3288	3273- 3286	Arbuckle li; Ord	P 108	....
Stafford		Musgrove Pet. Corp's Hart 1, SW SW NE 36-22s-14w, 3 mi se Nellie pl	8-23-49	3832	3826- 3832	Arbuckle li; Ord	P 472; 42 wtr	35
Stafford	Grow	Westgate-Greenland Oil Co's Grow 1, SW SW SE 16-21s-13w, ½ mi n Hazel pl.	8- 2-49	3712	3705- 3712	Arbuckle li; Ord	P 132; 5 wtr	....
		KANSAS—Oil Field Extension						
Russell	Unnamed	Lindas Oil Co's Dumler 1, NW SW SW 16-14s-13w, ¾ mi se extension	8-23-49	2436	2408- 2436	Tarkio li; Penn	P 12	....
		KENTUCKY—New Oil Fields						
Union		I. W. Hartman-Calvert & Willis Inc's Culver Hrs 1, 1910 fr nl 3365 fr el 11-P-20, 1½ mi nw Robinsonville fld.	8-18-49	2675	2302- 2310 2513- 2521	Cypress sd; Miss O'Hara li; Miss	P 55; 14 wtr	....
Union		Ryan Oil Co.-George & Wrather Drlg Co's Chas. Greathouse Hrs 1, SEC 24-Q-20, 2½ mi s Powells Lake pl.	7-19-49	2251	2243- 2251	Cypress sd; Miss	P 150	....
		KENTUCKY—Oil Field Extension						
Daviess	Glenville	A. Teller, Tr's J. C. Martin 1, 13-N-28, ½ mi nw extension	8-23-49	1645	1643- 1645	Bethel sd; Miss	P 20	....
		NORTH LOUISIANA—Oil Field Extension						
Sabine	Converse	Potter & Spellisy's Long Bell Lbr 2, 1885 fr nl 990 fr wl 6-8n-13w, extension	8-30-49	2080	.....	Chalk; U Cre	P 80	....

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian: U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

18 years

OF SEISMIC PROSPECTING EXPERIENCE GAINED IN WORLD WIDE OPERATIONS

Only in an integrated organization as large as SSC can the experience necessary to produce accurate Final Maps and Reports be brought to bear on your exploration projects.

SSC's standards for crew operating procedures and for interpretation and review, result in greater accuracy and more specific definition of geologic structure.

Seismograph Service Corporation

TULSA, OKLAHOMA, U.S.A.

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in August, 1949

(CONTINUED)

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		SOUTH LOUISIANA—New Oil Fields						
Beauregard	.....	Atlantic Rfg Co's Sabine River Lbr Co 1-A, 560 s 760 e of NWC Sect. 24-5s-13w, 2 mi sw Bivens, W.	8-29-49	9586	9304- 9323	Wilcox sd; Eoc	F 230; 1/32"	39.6
Cameron	.....	Kerr-McGee Oil Ind., Inc. & Phillips Pet Corp's State-Block 33-1, center of 19,760-ac Lse, 2½ mi in Gulf of Mexico.	8-24-49	13282	10390-10408	Miocene	F 934; 7/32"	42.2
Plaquemines	.....	Barnsdall Oil Co's Breton-St. Lse 1227-5, Blk 32, Breton Sound	8-26-49	9022	5802- 5804	.....	F 187; 1/32"	25.1
St. Landry	.....	Atlantic Rfg Co's Albert Meche 1, NEC Sect. 9-7s-3e, 4 mi nw Shuteston.	8-11-49	9898	9474- 9482	.....	F 45; 1/8"	36.5
		SOUTH LOUISIANA—New Oil Pay						
Point Coupee	Fordoche	The Texas Co's J. O. Long et al 3, 3300 e 660 s fr NWC 29-6s-8e	8-29-49	9600	8798- 8802	.....	F 155; 3/64"	38.5
		SOUTH LOUISIANA—New Distillate Fields						
Jefferson Davis	.....	Continental Oil Co's R. A. Estes 1, 1995 n 2000 w fr SEC 11-9s-5w, 1½ mi fr ne flk of Welsh Dome.	8- 5-49	11474	11374-11387	Lower Miocene	F 72; 2.5 mln; 1/16"	41.4
St. James	.....	Humble O&R Co's Burton-Swartz Land Corp. 2, Sect. 51-12s-15e	8-26-49	11450	10838-10848	.....	F 227; 1/4"	52.4
		MICHIGAN—New Oil Field						
Allegan	.....	W. Spencer Cook, Inc. & H. L. Wadsworth's Marshall 1, SE NE NE 11-1n-16w, Casco Twp, 5 mi ne Hawkhead fld.	8- 3-49	1187	1183- 1187	Traverse li; Devo	F 360	41
		MONTANA—New Gas Field						
Fallon	.....	F. H. Becker's Becker-Brandt 1, SE SW SE 18-5n-60e, Plevna area	8-25-49	1220	1160- 1220	Judith River sd; U Cre	0.5 mln	....
		NEW MEXICO—New Oil Field						
Lea	.....	Amerada Pet Corp's J. T. Caudle 1, 1980 fr nl 660 fr el Sect. 10-12s-33e, 1 mi sw BTA area prod.	8- 1-49	11083	9028- 9040	Pennsylvania li; Penn	F 285; 7 wtr; 1/2"	46.8
		NEW MEXICO—New Oil Pay						
Lea	Crossroads	Magnolia Pet Co's Santa Fe 1-B, 1980 fr sl 660 fr el Sect. 38-9s-36e	8-12-49	9888	9750- 9755	Pennsylvania li; Penn	P 175; 136 wtr	47
		NEW MEXICO—New Gas Fields						
Eddy	.....	The Texas Co's Z. A. McMillian 1, (OWWO), 1980 fr sl 660 fr wl Sect. 3-19s-37e.	8-16-49	7448	2980- 3085	.....	0.6 mln	....
Rio Arriba	.....	Stanolind O&G Co's Rosa Unit 1, C SW SE 11-31n-6w	7-13-49	8087	7890- 8056	Dakota sd; U Cre	0.6 mln	....
		OKLAHOMA—New Oil Fields						
Garvin	Roady, NE	Stanolind O&G Co's Richardson Unit 1, SW SE NE 1-1n-1w, 1 mi n Hoover, N. pl.	8-11-49	4664	4573- 4589	2nd Deese sd; Penn	F 80; 1/8"	27
McClain	Bradley, E.	Cities Service Oil Co's Dacus 1, C NW SW 29-5n-4w	8-11-49	11760	11179-11624	1st Bromide sd; Ord	F 88; 1/2"	44.2
Okfuskee	Blakely, SE.	Mid-Continent Pet. Corp's G. R. Weehunt 1, NW SE SE 6-11n-11e	8- 4-49	3779	3760- 3775	Wilcox sd; Ord	P 150	....
Pontotoc	Beebe, SE	W. C. McBride, Inc's L. A. Braley Est. 1, NE NW NE 9-4n-5e, 1¼ mi se Beebe pl.	8-22-49	3361	2052- 2059	Viola li; Ord	F 840; 3/4"	37
Seminole	.....	Lloyd Sanders' Danielson 1, (OWWO), NE SE SW 23-9n-7e	8-25-49	3572	3357- 3368	Booch sd; Penn	P 5; 80 wtr	....
Stephens	Palacine, NE.	Kingery-Patterson & A. C. McKoy's Weedn 1, SW SW SE 3-2s-6w	8-18-49	4863	4770- 4863	Simpson dolo; Ord	P 85; 125 wtr	39.5
		OKLAHOMA—New Oil Pays						
Lincoln	MidlothianNW	Falcon Seaboard et al's Yancey 1, (OWWO), SE SE NW 26-14n-3e	8-23-49	4124	4059- 4095	Oswego li; Penn	F 52; 1"	46
McClain	Lindsey, NE.	Bauman & Pray's Ainsworth 1, (OWWO), NE NW SE 26-5n-4w	8-11-49	10997	8206- 8244	Deese sd; Penn	F 115; 3/4"	41
Pottawatomie	Avoca	Flynn Oil Co's Cecil 1-B, SW NE NE 6-6n-4e	7-28-49	3748	3730- 3748	Senora sd; Penn	F 180; 1/4"	....
Pottawatomie	Tecumseh	Stanolind O&G Co. & Amerada Pet. Corp's Billington 1-B, (OWWO), SW SE SW 32-9n-3e.	8-18-49	5320	4884- 4960	Hunton li; Devo	F 144; 1/8"	....
Stephens	Placine, S.	Sunray Oil Corp's Nichols 4, SE NW NE 21-2s-6w	8- 4-49	2652	2585- 2650	Arbuckle li; Ord	F 98; 1/4"	36
		OKLAHOMA—Oil Field Extension						
Garvin	Hoover, NW.	W. B. Cleary-W. B. Smith & J. L. Webb's Ayers 1, SE NW NE NW 19-1n-1e, e extension.	8-18-49	1720	14 1440	Pontotoc sd; Penn	F 80; 11/64"	39.6
		OKLAHOMA—New Distillate Field						
Hughes	.....	Mid-Continent Pet. Corp's McCosar 1, SW SW NE 14-8n-10e, 1½ mi nw Greasy Creek fld.	7-28-49	3293	3259- 3264	Cromwell sd; Penn	F 44; 8.3 mln; 1/2"	....
		OKLAHOMA—New Gas Fields						
Hughes	.....	Joe Josephson & V. E. Autry's Claude Meadows 1, NE NE SE 14-9n-12e, se of Dustin.	8-25-49	3496	3440- 3496	Cromwell sd; Penn	5.1 mln	....
		OKLAHOMA—New Gas Pay						
Pototoc	Bebee, SE	W. A. Delaney, Jr.'s Wilburn Hrs 1, SW SE NE 4-4n-5e	8-26-49	1465	1440- 1465	Calvin sd; Penn	7 mln	....
		PENNSYLVANIA—New Gas Field						
Westmoreland	.....	Peoples Natural Gas Co's William Piper 1, Unity Twp	8-26-49	8552	8301- 8360	Oriskany sd; Devo	0.2 mln	....
		TEXAS—District 1 (S. CENTRAL)—New Oil Fields						
Bastrop	.....	Jesse I. White's Martin McDonald 1, 150 fr w&swl of 54-ac Lse, M. Baker Sur, 8 mi sw Bastrop.	8- 5-49	1881	1869- 1881	Dale li; U Cre	F 112; 1/4"	40
Caldwell	Staples	Fred J. Adams' Mrs. Fred J. Adams 1, 4000 fr swl 330 fr sel of 756-ac Lse, S. B. Morrosion Lge, 2 mi s Martindale.	8-16-49	704	671- 704	.....	P 23	36
Guadalupe	.....	J. M. Turkel's J. B. Burns 2, 4100 fr sel 9400 fr swl Samuel Highsmith Sur, 4 mi w Luling.	8- 2-49	2274	2225- 2267	Austin Chalk li; U. Cre	P 44	37
Guadalupe	"Jayeddie"	R. L. Turner & Sam Maceo's August G. Bode 1, 150 fr nl 100 fr wl 91.47-ac Lse, J. W. Williams Lge, 2 mi nw Zoborowski fld.	8-25-49	2085	2015- 2105	Austin Chalk li; U Cre	F 226; 1/4"	29
		TEXAS—District 2 (MIDDLE GULF)—New Oil Fields						
Jackson	.....	Houston Oil Co's B. W. Trull et ux 1-A, 1650 fr nel 2400 fr nwl Sect. 15, Geo. Williamson Sbdn, Pat Green Sur, ¾ mi e Francitas fld.	8-25-49	10514	7947- 7953	.....	F 61; 1/8"	41.4
Lavaca	Provident City, E.	Great Lakes Carbon Corp et al's Wm. Allen 1, 467 fr el 1650 fr sl Wm. Bell Sur, 1 mi e Provident City fld.	7-22-49	6157	6113- 6120	Yegua sd; Eoc	F 103; 1/8"	45
		TEXAS—District 2 (MIDDLE GULF)—New Distillate Fields						
Goliad	Albrecht-Pettus	Wood Oil Co et al's C. C. Ramsey 1, M. de J. Ybarbo Sur, 4 mi n Riverdale	8-24-49	5325	4512- 4514	Pettus sd; Eoc	F 10; 15.8 mln; open	60
Live Oak	Karon	Tide Water Assoc. Oil Co's Geo Maguglin 1, 660 fr se&swl J. Poitevent Sur 37, 2½ mi e Coquat fld.	8-11-49	8546	8180- 8190	Mass. Wilcox sd; Eoc	F 108; 3.8 mln; 1/4"	....
		TEXAS—District 2 (MIDDLE GULF)—Distillate Field Extension						
Live Oak	Clayton	Magnolia Pet Co's C. S. Herring et al 1, 1485 fr sl 2310 fr wl Sect. 64, Tr. 3127, Blk 64, C. F. Simmons Nueces River Sbdn, BS&F Sur 247, ⅔ mi e extension.	8-14-49	6980	6468- 6478	.....	F 520; 39 mln; open	60
					6936- 6944	.....	F 422; 19 mln; open	60
		TEXAS—District 2 (MIDDLE GULF)—New Gas Pay						
Lavaca	Speaks	Fidelity Oil & Rlty Co's Kittie Clark 1, 330 fr n&wl Amanda de la Crois Sur, ¾ mi s-se production.	8- 9-49	5620	5273- 5278	.....	No gge	....
		TEXAS—District 3 (UPPER GULF)—New Oil Field						
San Jacinto	"Lick Branch"	Floyd L. Karsten's Quinn-Bevil 1, 3650 fr nl 330 fr el 3000 fr sl B. B. Sturgess Sur, 2 mi se Mercy fld.	8-15-49	8626	8614- 8624	.....	F 156; 1/16"	40.5
		TEXAS—District 3 (UPPER GULF)—New Oil Pays						
Brazoria	Bryan Mound	Freeport Sulphur Co's Freeport Sulphur Co 2-A, Henry Burt Sur, s flk of fld.	8-13-49	1388	1360- 1381	.....	F 55; 3/64"	33.5
Galveston	Gillock	John W. Mecom's Maco Stewart 1-B, 3100 fr wl 7350 fr sl W. K. Wilson Lge, sw of prod.	8-24-49	8794	8766- 8788	.....	F 301; 1/4"	37
		TEXAS—District 3 (UPPER GULF)—New Distillate Field						
Harris	Cypress	Claud B. Hamill & Lenoir M. Josey's H. J. Logenbaugh 1, 380 fr wl 990 fr sl A. Roberts Sur, 2 mi sw Cypress.	8-10-49	7075	7024- 7036	.....	F No gge; 1.4 mln; 1/2"	60.5
		TEXAS—District 4 (LOWER GULF SW)—New Oil Fields						
Nueces	London Gin	Grace Oil Co's L. F. Allen-Doughty 1, (OWWO), 660 fr n&el Sect. 1, Laureles Fm Trs., 2 mi n London fld.	8-11-49	616	4499- 4507	Miocene	F 76; 1/8"	32.3
Nueces	.....	Producers Dev. Co's Veronica McCullough 1, Blk 39, Richard King Fm Lots, 1 mi se Richard King fld.	8-10-49	5594	5538- 5548	.....	F 8; open	38

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Camb, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

EXACT DEGREES OFF VERTICAL... *Every Time*

with the IMPROVED E-C INCLINOMETER

You get STRAIGHT HOLE DRILLING INSURANCE when you get Sperry-Sun's *Improved* E-C Inclinometer on the job. Everything necessary to assure quick, positive, accurate, easily read and permanent records at any depth is here, in one simple, convenient package.

The *Improved* E-C Inclinometer can be Go-Deviled, thanks to an automatic circuit breaker now provided to break the electric circuit after your fractional degree record has been made. It can also be run by any other conventional method in either rotary or cable tool operations, such as: On wire line, core barrel overshot, or inside bailer.

Operated by dry cell batteries on electro-chemical principles, the *Improved* E-C Inclinometer provides multiple records in a single round trip . . . it double checks each record . . . it requires no complicated developing, furnishing immediately the information you want right on the job.

E-C Inclinometers are furnished on a low-cost, lease-rental basis, and are factory maintained to assure perfect operating conditions at all times.

Get STRAIGHT HOLE DRILLING INSURANCE by calling our nearest service engineer.

OTHER SERVICES

Surwel Service • Syfo-Clinograph • Non-Magnetic Drill Collar • Electronic Meter Service

SPERRY-SUN

SPERRY-SUN WELL SURVEYING COMPANY

3118 BLODGETT AVENUE HOUSTON, TEXAS

Philadelphia, Pa. Falfurrias, Texas Odessa, Texas Marshall, Texas Long Beach, Calif. Oklahoma City, Okla.
Lafayette, La. Bakersfield, Calif. Moulden Oil Field Services, Casper, Wyo. Crossville, Illinois

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in August, 1949

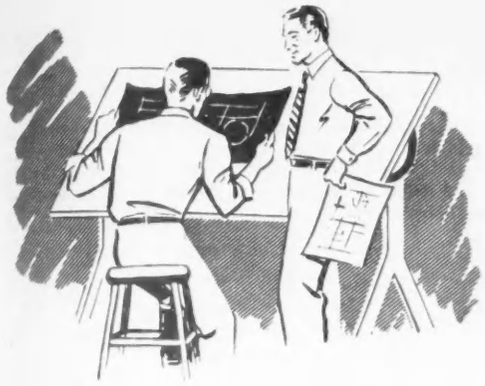
(CONTINUED)

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		TEXAS—District 4 (LOWER GULF-SW)—New Oil Pays						
Nueces	West Corpus	The Chicago Corp's J. C. Wilson 2, 660 fr s&el Lot 1, Sect. 6, Rge 7, J. C. Russell Frs Tr.	8- 3-49	9309	8348- 8358		F 99; 7/64"	42
San Patricio	Plymouth, E.	F. M. Boykin, Jr's W. P. Mullen 1, (OWDD), 1400 fr nl 466 fr wl Blk 1, Sect. 27, 4th addn to Taft Frm Lds.	7-29-49	5525	4880- 4883		F 82; 1/8"	28.5
Starr	Rincon	Continental Oil Co's T. B. Slick Est. 120-B, 1320 fr nl 1270 fr wl A. C. Truitt Sur 266.	8- 2-49	8514	6224- 6235	Rincon sd; Olig.	F 104; 1/16"	42.3
Willacy	La Sal Vieja	J. S. Abercrombie Co. & Magnolia Pet Co's R. F. Robinson 1, 330 fr n&wl Lot 2, Blk 4, Narcisso Tr. 4, San Juan de Carricitos Gr.	8-25-49	8814	8329- 8344		F 184; 1/16"	39.4
		TEXAS—District 4 (LOWER GULF-SW)—Oil Field Extension						
Kenedy	Rita	Humble O&R Co's Mrs. S. K. East 3, 12,800 fr wl 13,155 fr sl Los Finados Gr, 1 mi nw extension.	8- 4-49	9708	5120- 5130		F 41; 1/8"	47
		TEXAS—District 4 (LOWER GULF-SW)—New Distillate Fields						
Brooks		Humble O&R Co's R. J. Kleberg, Jr. Tr. 1, 1980 e&s fr SWC Sur 82, Santa Quiteria Gr, 7 mi e Encino.	8-21-49	10382	8123- 8135		F 51; 2.1 mln; open	55.6
Hidalgo		Sinclair O&G Co's John Jancik 1, 660 fr w&sl Lot 10, Blk 16, Porc. 72, Alamo Ld & Sugar Co. Sbdn, 3½ mi w Alamo fld.	8-31-49	9215	6575- 6640		F 140; 7 mln; open	65
		TEXAS—District 4 (LOWER GULF-SW)—New Gas Field						
San Patricio		Curtis Singleton Drlg Co's J. H. Ewing 1, (OWWO), Blk 6, Sect. 13, Geo. H. Paul's Sbdn of Coleman-Fulton PCL, 2 mi s Sinton.	6- -49	7215	5536- 5543		3 mln; 1/8"	....
		TEXAS—District 4 (LOWER GULF-SW)—New Gas Pay						
Duval	Hoffman	J. W. Cosner's W. K. Hoffman 1, 900 fr swl 700 fr sel Sur 116, 7 mi se Freer	8-10-49	2067	2005- 2026		4 mln; open	....
		TEXAS—District 6 (NORTHEAST)—New Oil Field						
Wood		Shell Oil Co's Consumers Lignite Co. 1, 60-ac Tr, Friend McMahan Sur, 2 mi s Alba.	8-19-49	4746	4197- 4198	Sub-Clarksville sd; U Cre	P 21	17.1
		TEXAS—District 7-B (N. CENTRAL)—New Oil Fields						
Erath		Amburgey-McClung-Amburgey's W. R. Miller 1, 3750 fr el 330 fr sl Thos. Harrell Sur, 5 mi se Thurber.	8-16-49	4002	3952- 3982	Ellenburger li; Ord	P 41	40
Jones		C. U. Bay & Taubert Drlg. Co's E. E. Farnsworth 2, 330 fr n&wl Blk 1, Lge, 358, Goliad CSL Sur, 1¾ mi nw Bartlett fld.	8-25-49	3158	3150- 3158		F 1176; ½"	37
Nolan		Skelly Oil Co's E. A. Ater 1, 330 fr nl 2500 fr wl Sect. 67, Blk 23, T&P Sur, 5 mi sw Roscoe.	8- 9-49	7155	7097- 7118	Ellenburger li; Ord	P 154	44.2
Shackelford		H R H Drilling Co's Dell Newell 1, 50 fr el 874 fr sl SE¼ Sect. 59, ETRR Sur, 3½ w mi nw Albany.	7- 2-49	1263	1257- 1263	Tannehill sd; Penn	P 25; 5 wtr	38
Shackelford		Jack H. Moore's Dawson & Conway 2, 660 fr sl 220 fr wl Sect. 194, ETRR Sur, 5 mi e Lueders.	8-19-49	1537	1531- 1537	Humble sd; Penn	P 102	37
Throckmorton		Deep Rock Oil Corp's Thomas W. Foreman 1, 330 fr n&wl Sect. 3040, TE&L Sur, 5½ mi ne Throckmorton.	8-16-49	5311	4497- 4540	Caddo li; Penn	P 53	37.5
Throckmorton		Turner & Duvall's E. A. Posern 1, 330 fr sl 1990 fr wl Sect. 682, TE&L Sur, 2½ mi se Woodson.	8-30-49	4510	4474- 4510	Caddo li; Penn	F 300; 7/32"	39.4
		TEXAS—District 7-B (N. CENTRAL)—New Oil Pay						
Jones	Jones Reg	Manley Bros. & Barron's Abbie E. Harvey 2, 1890 fr nl 990 fr wl Sect. 9, Blk 14, T&PRR Sur, 2 mi e Nugent.	8-30-49	1855	1830- 1855	U Hope li; Penn	P 43	36.5
		TEXAS—District 7-B (N. CENTRAL)—New Gas Pay						
Stephens	O'Neal-Caddo	McElroy Ranch Co's A. N. Sayre et al 1, 1800 fr sl 660 fr wl Sect. 2, Blk 8, T&P Sur, 4 mi w Breckenridge.	7-28-49	4501	4000- 4005	Marble Falls li; Penn	1.5 mln; open	....
		TEXAS—District 7-C (W. CENTRAL)—New Oil Fields						
Runnels		Fred M. Manning, Inc's S. L. McNay 1, 3925 fr nwl 2582 fr swl Sect. 293, J. Jefferies Sur, 3½ mi nw Wingate.	7- 8-49	5626	5282- 5290	Pennsylvania sd; Penn	P 55	42
Runnels		E. S. Price Oil Co's A. Malone 1, 4250 fr el 381 fr sl M. J. Parramore Sur, 26 mi ne Ballinger.	6-15-49	2387	2379- 2387		P 8	42
		TEXAS—District 7-C (W. CENTRAL)—New Oil Pay						
Runnels	Beddo	Chapman & McFarlin's W. B. Dankworth 1, 330 fr sl 1086 fr el Sbdn 52, Domingo Dias Sur 532, 6 mi ne Ballinger.	7-30-49	3971	3720- 3725	Jennings sd; Penn	F 624; open	46.6
		TEXAS—District 7-C (W. CENTRAL)—Oil Field Extensions						
Coke	Millican	Sun Oil Co's Annie Cummings 5, 660 fr n&wl Sect. 187, Blk 2, H&TC Sur, ½ mi nw extension.	7-29-49	6039	5903- 6039	Strawn li; Penn	F 257; ¼"	45.5
Tom Green	Susan Peak	Plymouth Oil Co's John D. Robertson 1-C, 1070.9 fr sl 1168.3 fr wl E. Abbott Sur, ½ mi sw extension.	8-13-49	4885	4854- 4885	Strawn sd; Penn	F 358; ¼"	37.8
		TEXAS—District 8 (WEST)—Oil Field Extensions						
Andrews	Dollarhide	Magnolia Pet. Co's E. P. Cowden 21-B, 660 fr wl 1980 fr nl Sect. 3, Blk A-55, PSL Sur, 1, mi e extension.	8-30-49	12020	8424- 8670	Silurian li; Sil	F 320; 5/8"	38.8
Cochran	Callis	Atlantic Rfg Co's F. O. Masten 1-C, 694.4 fr s&el of NW¼ Lab. 18, Lge 133, Armstrong CSL Sur, 1¼ mi sw extension.	7-30-49	5095	4985- 5050	San Andres li; Perm	P 90; 83 wtr	31.8
Ector	Goldsmith-Clear Fork	Texas Pacific C&O Co's C. Scharbauer 33, 660 fr n&el Sect. 31, Blk 44, T-1-N, T&P Sur, 3 mi nw extension.	7-17-49	8289	5472- 5738	U Clear Fork li; Penn	F 143; ½"	37
Ector	Goldsmith, N. 5400'	General American Oil Co's C. F. Scharbauer-Penn 40-1, 660 fr s&el Sect 29, Blk 44, T-1-N, T&P Sur, 1 mi ne extension.	8-31-49	6301	5496- 5616 6133- 6190	U Clear Fork li; Penn L Clear Fork li; Penn	F 251; 5/8" F 353; ¼"	35.3 38.7
Ector	Jordan-Ellen	Amerada Pet Corp's Hattie E. Connell 1, 660 fr n&wl Sect. 12, Blk B-16, PSL Sur, ne extension.	8- 5-49	8965	8930- 8965	Ellenburger li; Ord	F 596; ½"	45.2
Scurry	Snyder, N	W. A. Moncrief et al's C. W. Huckabee 1, 660 fr n&el NW¼ Sect. 160, Blk 3, H&GN Sur, 1½ mi se extension.	8-23-49	6800	6680- 6800	Canyon li; Penn	F 1078; ½"	43.5
		TEXAS—District 9 (NORTH)—New Oil Fields						
Baylor		American Liberty Oil Co's J. S. Criswell 1, 2310 fr el 990 fr sl Sect. 97, T&NO Sur, 8 mi s Seymour.	8- 3-49	5575	5160- 5170	Caddo li; Penn	P 15; 40 wtr	44
Clay		Jack Grace Prod. Co's W. C. Fields 1, 330 fr s&el Blk 19, Grayson CSL Sur, 3 mi nw Blue Grove fld.	8- 8-49	5946	5921- 5946	Caddo li; Penn	F 168; 1/16"	41
Cooke		Snuggs & Neal Inc's G. A. LeMaster et al 2, 330 fr sl 1058 fr wl of N½ of of SW¼ Blk 2, Lge 7, University Lds, 10 mi ne Gainsville.	8- 9-49	2754	2747- 2754	Strawn sd; Penn	F 119; 5/8"	43
Jack		Walter L. Plemons Prod. Co's S. C. Cooper 1, 1203 fr sl 330 fr wl Sect. 3314, TE&L Sur, 1¼ mi nw Peek fld.	8-13-49	4566	4538- 4566	Caddo li; Penn	F 336; 32/64"	42
Montague		C. U. Bay's D. C. Gregory et al 1, 660 fr ne&sel of W½ Sect. 28, W. A. Payne Sur, 1 mi e Magee fld.	8-22-49	6690	6165- 6190		P 82	43
Wichita		Panhandle Prod. & Rfg Co. & Gordon F. West et al's Wichita Valley Fms Unit 1, 1920 fr el 2900 fr sl W. M. Lloyd Sur, 1 mi ne Norwood fld.	8-31-49	4438	4126- 4134		P 83	42
Young	Rice	Lawrence Hillhouse's Geo. Rice 1, 450 fr n&wl Sect. 405, TE&L Sur, 6 mi w Olney.	8-13-49	1293	1287- 1293		P 56	38
		TEXAS—District 9 (NORTH)—Oil Field Extension						
Grayson	Sherman	J. R. Adam Seitz & A. R. Dillard's Glenn D. Woodson 1, 330 fr el 1320 fr sl Uriah Burns Sur, ½ mi w extension.	8-17-49	4870	4858- 4870	Strawn sd; Penn	P 112	37
		TEXAS—District 9 (NORTH)—New Gas Field						
Jack		Russell Maguire's M. U. Johnston 1, 476 fr nw&swl SA&MG Sur, 2 mi se Worsham-Steed fld.	8-26-49	4471	4440- 4445	Conglomerate	2.8 mln	....
		WEST VIRGINIA—New Gas Field						
Wood		Columbian Carbon Co's C. W. Moore 1-1124, Steel district	8-11-49	4964	4885- 4908	Oriskany sd; Devo	1.2 mln	....
		WYOMING—New Oil Fields						
Laramie		The California Co's Morton-King 1, NW SW 13-13n-68w, Borie prospect in Denver Cheyenne Basin.	8- 7-49	11375	8540- 8565	Muddy sd; U Cre	F 240; 5/8"	39.3
Natrona	Sage Spring Creek	Amerada Petroleum Corp's Unit 1, C SW SE 30-37n-77w	8-30-49	9539	7250- 7269	Dakota sd; U Cre	P 135	34.7
Weston	Fiddler Creek, W.	Mule Creek Oil Co. et al's Martin-Connally 1, SE NE NE 25-46n-66w, 3 mi sw prod.	8- 9-49	5725	5684- 5698	Muddy sd; U Cre	F 2736	38

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.



Engineering Simplifies *Steam Rig Hookup*

By ELTON STERRETT
Engineering Editor

PRODUCTION-LINE precision in rigging up has been equalled through the liberal use of engineering ingenuity in the designing of inter-related units on the steam rig setup of the Housh Drilling Company. Starting the center line of the well as base line, pumps, steam lines and boilers are set at specified distances from the base, and are made up in units which are identical, so that any one except the end sections can replace or be substituted for another without welding, cutting or changing any fittings or connections.

Exhaust steam is used for furnishing boiler draft, which involves a steam return line paralleling the live steam header from the boilers. The two 6-inch steam lines are put up in units exactly 20 feet long, fitted with matching bolt-type unions, and aligned with end and mid-section plates. Through these plates pass the service lines for the rig, also equipped with quick-acting or hammer-type unions. Each piping unit is used to support the expanded-metal walkway, which extends between the two stacking plates on the ends of the unit. These plates are equipped with lugs which match recesses formed in the bases of the end plates, so that the pipe units, when stacked on a truck, are held against shifting and possible damage to walkway or union halves.

The same unitizing plan is followed in assembling the service lines for the derrick floor, with all unions in the same plane and matching accurately with counterparts on any other unit.

These lines are made up in 12-foot lengths and similar to the larger units but light enough so that they can be handled by hand in places inacessible to trucks. Service lines referred to are a steam line to the mud-pit jets, shale shaker, and floor; and a high-pressure water line with 6000-pound test fittings connected directly from the boiler feed pump to the blowout preventer control manifold on the derrick floor. A special unit serves to make the 90-degree turn in these service lines to bring them parallel with the desired side of the derrick floor. Instead of an abrupt turn, two 45-degree mitre turns are made in the pipe, with the short ends at each end of the section at 90 degrees to each other. Each of the sections is supported at only one point and will serve as stable walkway without intermediate bracing.

Unitized steam lines made up in 20-foot lengths, any slight difference in spacing or expansion of the mud-pump distribution skid and the boiler header is taken up by a reversed U-type swing with swivel unions, and the introduction of sleeve-type unions in the exhaust steam return line to stack blowers near the point where the unit sections begin.

Although different makes and sizes of mud pumps are used by the company, mud pump skids are made up to fall exactly within certain over-all dimensions, and all connections, regardless of pump size, match exactly with those of adjacent skids. The two transverse members of the skids are the two exhaust steam mains, engine and pump, while the longitudinal or longer skids are made of 14x8-inch I-beam, with a special notched end into which may be hooked a push-pull hoist for bringing the adjoining skids into alignment. Ball-type unions are used on the mud line, water lines and live steam lines, while the exhaust lines are tied together with notch-type

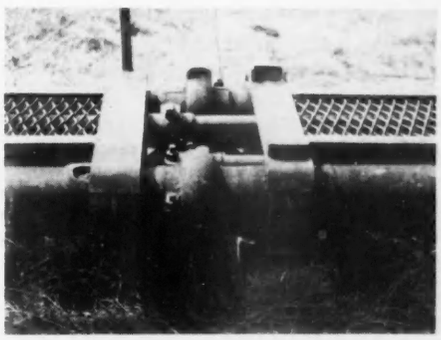
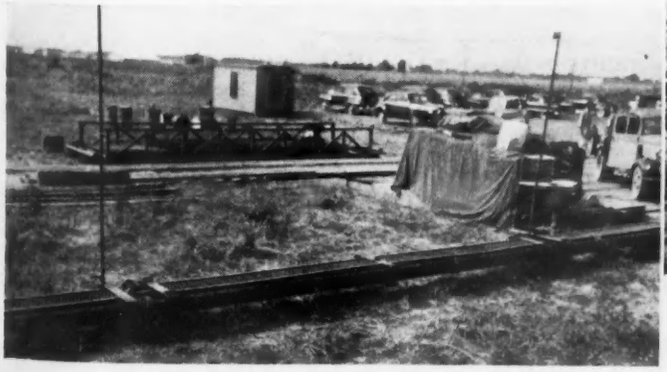


FIGURE 2. Close-up of the unions trying two adjacent lengths of the pipe assembly, showing the lugs to maintain the sections in a close stack when loaded for transportation. The method of mounting the expanded metal walkway between structural members welded atop the six-inch mains is clearly shown.

FIGURE 1. A typical unit of the pipe assembly from the boilers to the unitized mud pumps, with the exhaust steam line nearer the camera. The two steam lines are both attached to one end place, while one is left free to expand through the other, being guided and limited by pins and slots welded to the assembly.



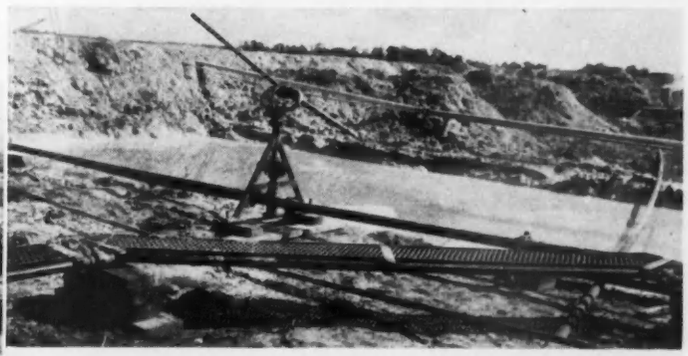


FIGURE 3. The special turn section of the service pipe group, with a 45-degree angle at each end and the entire unit forming a self-supporting assembly which will carry foot traffic without intermediate bracing.

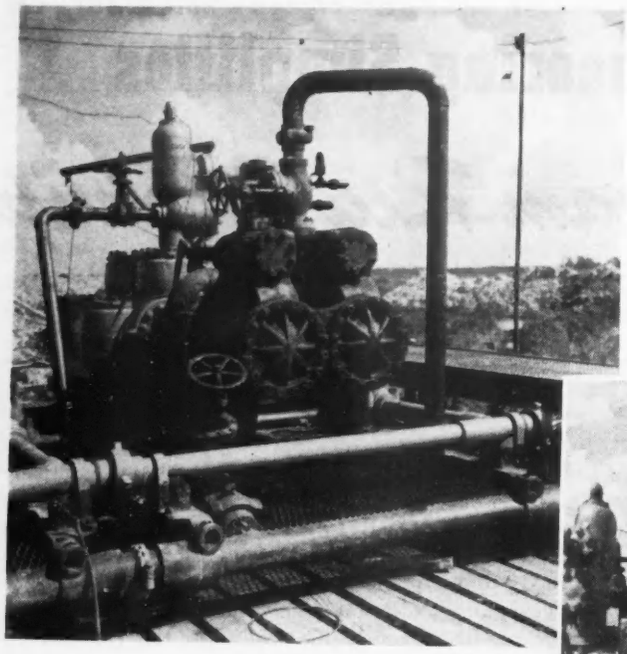


FIGURE 4 (Left). End of typical mud-pump skid, showing use of the pump exhaust line for end member of skid, and type of unions used to give necessary degree of flexibility in assembly. The difference in heights of different sizes and makes of mud pumps is compensated for by different length nipples between the throttle valve and steam arch.

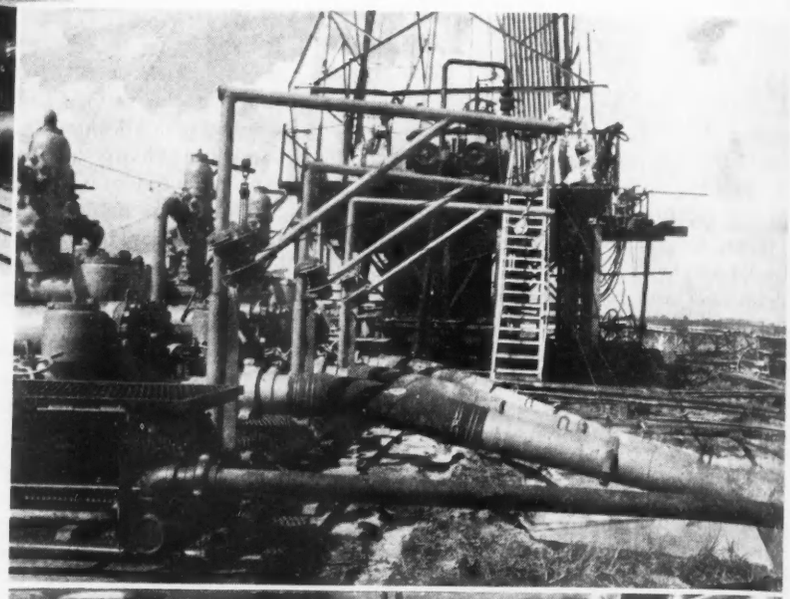


FIGURE 5 (Right). Suction side of mud pump battery, showing jib cranes, and dual lifting eyes for suspending suctions in pit, and for handling when stowing the flexible assembly alongside the pump on the skid for transportation.

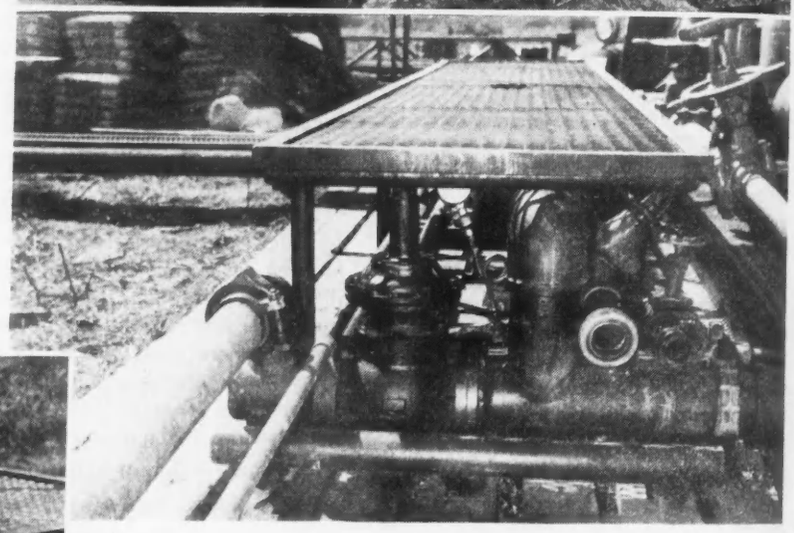


FIGURE 6 (Below). Close-up of construction of mud-pump skid end, showing notch in end of pump skid for attaching hook of push-pull jack for aligning adjacent skids. The method of supporting blanking plug in end of mud line under walkway illustrates attention to details in equipment design.

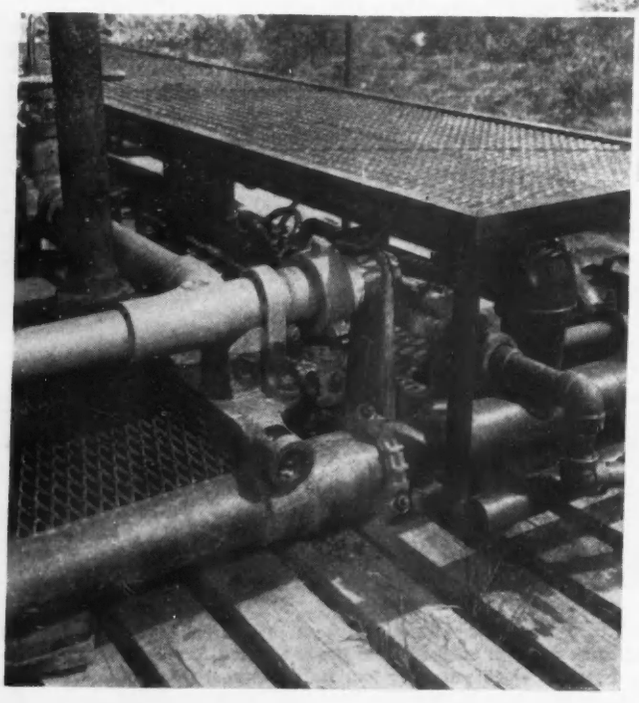


FIGURE 7 (Above). Exhaust header end of service skid attached at boiler end of mud pump battery, showing back-pressure relief valve to vent pits when exhaust pressure mounts above predetermined value. The skid serves as work platform for servicing first pump of the battery.

couplings which absorb minor irregularities in setting.

All steam lines to the pumps, as an example of standardization, are brought up to a certain height, with the only change to accommodate different steam chest heights being in the nipple which ties in between throttle and steam-line union. The same principle is used on all other lines on the pump skids.

To effect distribution of steam, water and mud, and to provide for exhaust pressure regulation, a special service skid is inserted between the end of the line of piping units and the boiler-side of the mud pump setup. This skid, with unions located to match those of the pipe units and the pump skids, carries such accessories as a unique trap for separating moisture from the live steam, and an adjustable relief valve in the exhaust return line so that excess steam is vented to a line over the shale pits when pressure exceeds the rated limit—usually 15 pounds. It also manifolds the engine exhaust with the pump exhaust so that the exhaust steam from either or both may be used for stack blowing. This skid is floored with expanded metal of the same type as used on the pipe units, and serves as work platform for servicing the first of the pumps. As with all other units, this one is equipped with a lifting eye at the center of balance so that one man can easily control the skid when it is picked up by a truck. To prevent such eyes being possible hazards to crewmen, they are recessed and accessible through small openings in the expanded metal walkways.

A similar skid-mounted manifold unit is mounted on the derrick side of the pumps. It provides connections for steam to the pit jets, mud to the guns, unitized water lines, steam to the drilling engine, mud to the hole, and separate water, mud and steam connections for service companies. This manifold unit incorporates a connection between the mud line and the high-pressure water line to the blowout preventer control manifold, thus providing the pressure from compounded mud pumps to operate the blowout preventers when necessary.

Each mud pump skid is equipped with a jib crane, supporting a worm-type winch whose line is threaded through a sheave at the end of the horizontal arm. Each mud suction is equipped with two loops for the winch line, one near the outer end for regulating the height of the suction in the mud pit, the other at the center of balance of the suction when the union at the edge of the pump skid is open. With the winch line hooked at the center of balance, the suction line may be picked up, swung around with the jib, and landed entirely within the pump skid for moving to the next location. To prevent possible loss of the blanking plug for the suction unions, they are attached to the pumps with short, heavy chains, welded to prevent possible "borrowing" or misplacement. Any two pumps may be easily compounded by inserting the blanking plug in the section of the high pressure pump and arranging the valves for pumping through the special compounding line, which passes through the pump skids under the suctions. This compounding line may be utilized for pumping on the hole in case of trouble in the main line for it is connected to the main mud line in the derrick-side manifold unit.

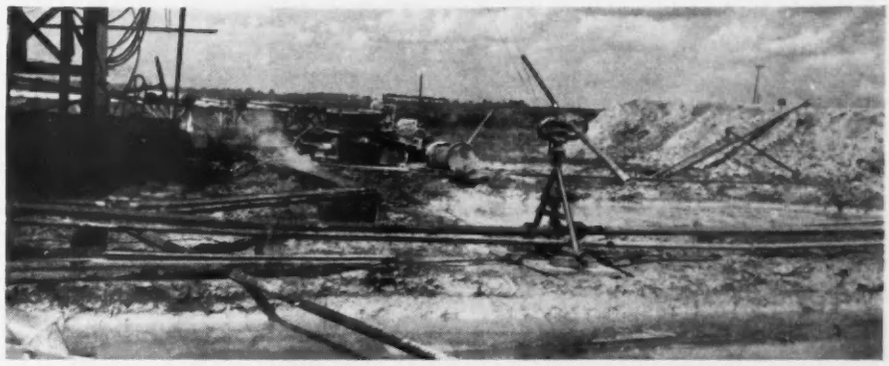


FIGURE 8. The eight-foot "pup" joint in the mud line to the mud guns is visible to the left of the mud gun, while a standard 16-foot unit is tied in to the right and connects the next mud gun to the supply.

The line to the mud guns is also made up in uniform lengths, 16 feet being selected so as to give the desired distance between guns. To enable the guns to be located where most effective in the pits, a "pup" joint, one-half as long as the standard, is included at each rig. This eight-foot section gives the desired variation in spacing of the guns from the take-off from the mud main.

The jet for emptying the shale pit is steam-powered, but the connection for live steam is made well up the run of the discharge line, so as to keep the union out of the mud and in position for servicing. This jet unit, in common with other special equipment, is fitted with a lifting eye or loop at the center of gravity so that it will balance easily when being moved.

A prefabricated, sectional pipe rack, designed so it may be extended at will in length or width, utilizes steel footings instead of the customary timber pads. The cross braces, formed from pipe with the ends flattened and pierced, fit over specially shaped pins on the uprights, and are removable only by being lifted and turned to clear the curved hooks on the standards. The drill pipe transverse members, from which the ends have been cut, rest in and are pinned to sockets formed on the braced uprights. Height of the uprights is regulated by pinning the two telescoping members, which are pierced with holes so spaced that any increment in height from one-half inch upwards may be secured simply by selecting the proper matching holes.

The ramp for the derrick is adapted from surplus war material, two pinned sections forming each rail or runway, properly spaced to accommodate the tread of the trailer carrying the equipment. The metal surface of the ramp gives excellent traction, at the same time being practically self-cleaning, as the openings are large enough to allow mud to be forced through and good contact between tire and skid obtained. The rigidity and strength of this ramp insure safety when loading or unloading equipment at the floor as is usually done with a "bob-tail" or gin-pole truck.

In service, a 3x12 timber is laid inside the rails of one part of the ramp, and used as a slide down which bits and subs are handled to the ground. The lower end of each section of the ramp rests on the timber turn around in front of the rig, while the pinned center and the upper end rest on footings fabricated at the company's shops. These footings are removable so that the uprights or legs fold against the heavy channel of the ramp for transporting and are pinned in place with the same pin which in the service position retains the diagonal brace in place. The ramp shown, in use with the derrick on a high single, 14-foot sub-structure, utilizes two sections of bridge, pinned together. For the higher derrick floor, the same grade and first two sets of supports are retained by adding a third bridge section and a pair of extended footings.

Through the development of engineering advances over former practice, such as those described herein, the company has been able to shorten the rigup time, as well as save material by having it fit without cutting or welding. Standardized connections on different makes of equipment simplify assembly. Utilization decreases the number of parts to be handled, thus reducing transportation and handling costs and providing protection for the parts. Accurate fitting together of the many units entering into a rig also reduces the hazard to crew members when rigging up or tearing down and lightens the work demanded of each man.

(See Photos on Next Page)

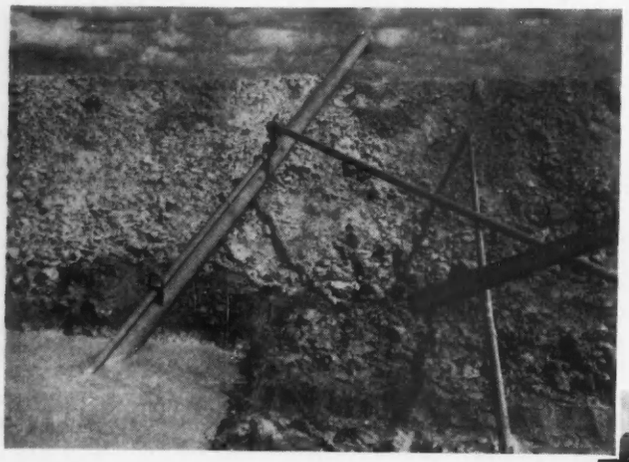


FIGURE 9 (Left). Shale jet, showing high tie-in of steam line, and loop at point of balance for hooking on winch line when shifting or loading the unit.

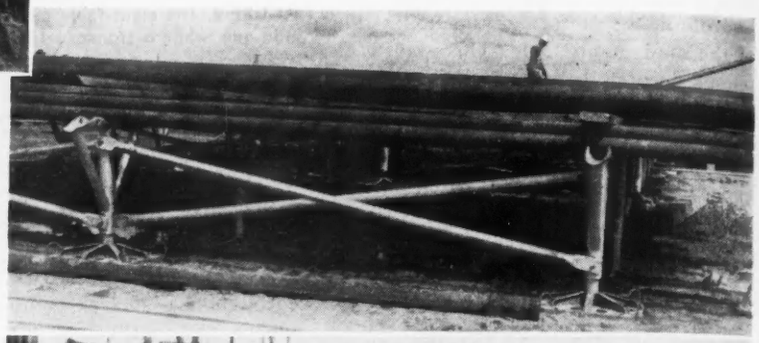


FIGURE 10 (Right). Bracing and special sockets for attaching additional drill-pipe top rails to the specially designed pipe rack. Braces are made to template and are interchangeable throughout the rack assembly.

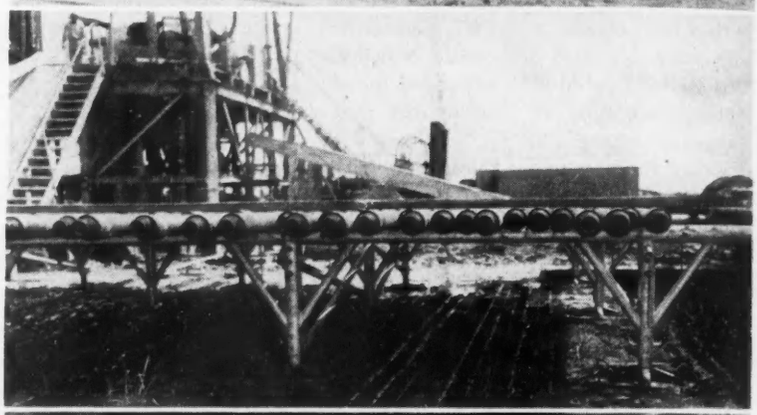
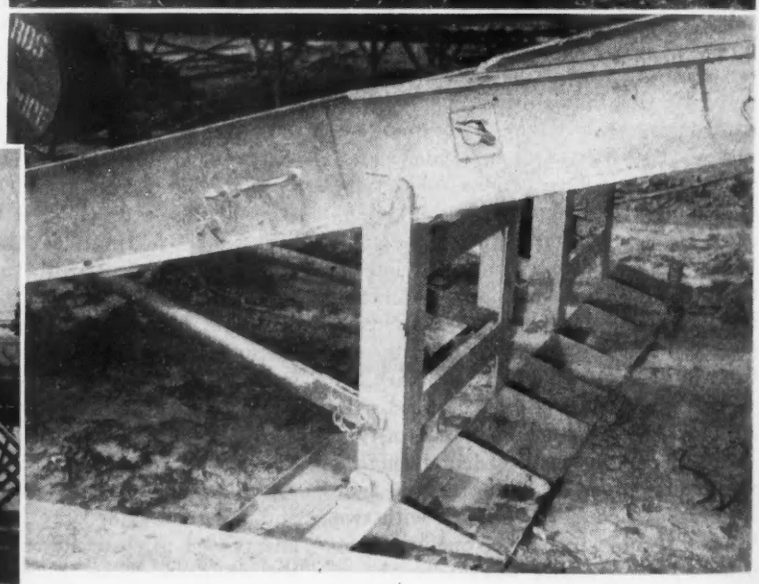


FIGURE 11 (Right). Supports for pipe rack, showing braces for special tie-in sockets, and, left center, the method whereby holes in the telescoping members of the uprights are spaced so as to give adjustment within one-half inch.

FIGURE 12 (Below). The ramp with its heavy channel steel rails and metal tread gives excellent traction and protects against possible accident to the trailer or truck as it is being backed into position at the edge of the derrick floor.



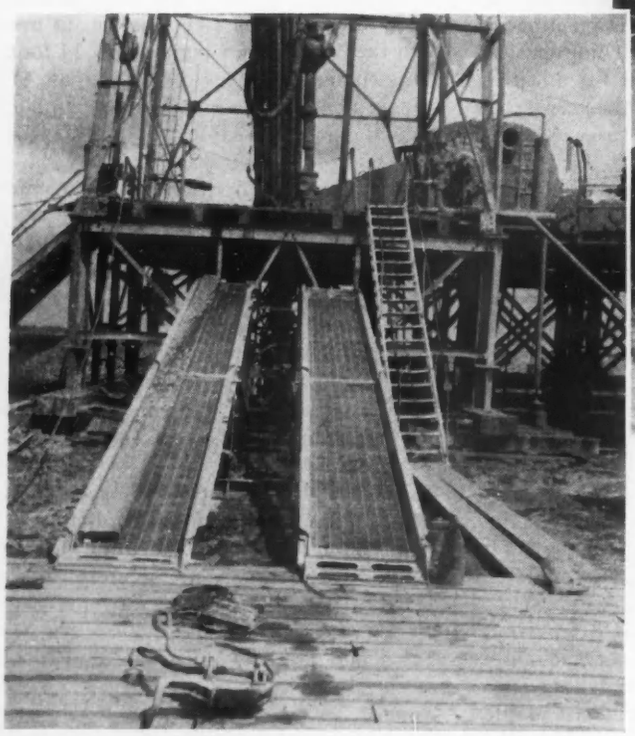


FIGURE 13 (Above). Intermediate supports and portable footing for ramp, showing method of bracing and dual pins for rigidly joining adjacent sections of ramp. Uprights swing against and are pinned to side rails during transportation.

TEAM POWER!

Sensational Wilson

GIANT TORCAIR RIG

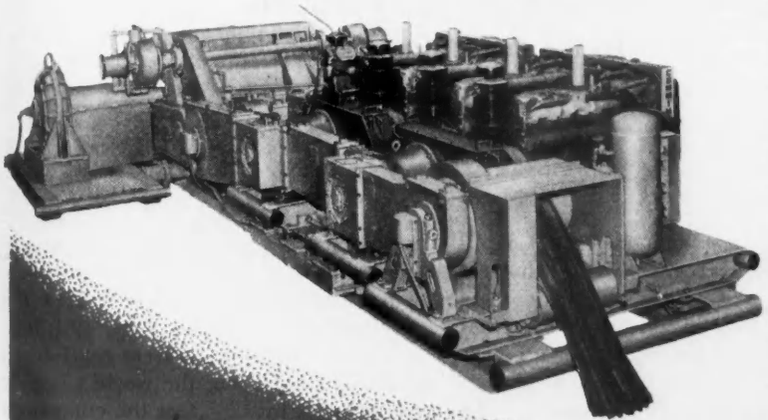
and

CUMMINS "Dual NH"

DIESEL HYDRAULIC ENGINES!

For The First Time! Flexibly Teamed Engines Successfully Combined with World-Famed Wilson Rigs Equipped with Air-Tube Disc Clutches & Air Controls!

COMPARE PRICES BEFORE YOU BUY!



Both are years ahead in engineered efficiency. NOW teamed to give you SMOOTHER, MORE FLEXIBLE POWER! The WILSON Giant Torcair is COMPLETELY AIR CONTROLLED, with FULL VISION PANEL CONTROL. Torque converter drives on 1, 2, or 3 engines. Full circulating water cooled brakes. Reverse speeds automatically engaged. Single or Multiple Engine Drive. Air-Tube Disc Drum Clutches. Full 42" Drum. The Cummins Diesel tends to overcome inadequate torque at starting speeds. This unit consists of two six-cylinder four-cycle Cummins "Dual NH" Dependable Diesel Engines, two Clutches, and two Hydraulic Couplings . . . assuring "cushioned power." Write for WILSON BULLETIN 172.

Wilson

MANUFACTURING CO., INC.

WICHITA FALLS, TEXAS

Pacific Coast Distributor — Power Rig & Equipment Co. — Los Angeles, California

Export Agents — Dunkels, Seebold & Associates — 50 Rockefeller Plaza — New York City

Langtry y Cia. Corrientes 1110, Buenos Aires, Argentina — 25-28 — Shorted 9228

AMERICA'S LARGEST BUILDER OF RIGS AND WINCHES — *There's a reason*

World's Biggest Rig Drills World's Deepest Well

This view, taken while seven-inch casing was being run, shows what nearly 20,000 feet of drill pipe looks like when stacked up in the derrick. String consisted of about 14,000 feet of 4½-inch pipe and the remainder of 3½-inch.

Photo from The National Supply Company

Some Superlatives:

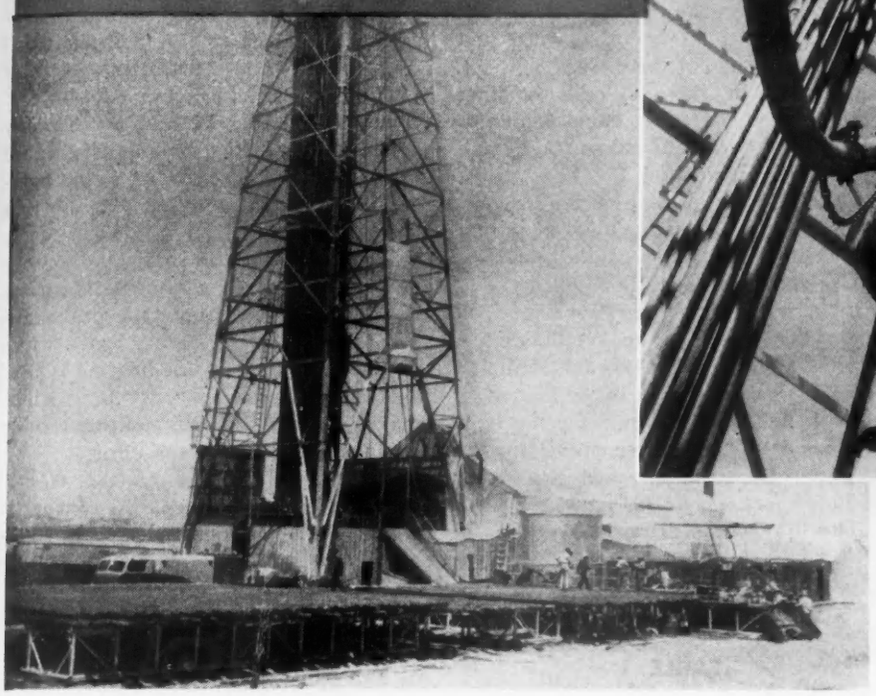
1. World's deepest hole, drilled to total depth of 20,521 feet.
2. Largest drilling rig ever used.
3. Longest string of casing ever run: seven-inch casing set at 19,765 feet.
4. Largest diameter drilling line ever used for drilling: 1½-inch.
5. Largest crown and travelling block ever constructed.
6. Greatest depth to which well ever has been drilled with diesel power, previous world's records having been established with steam power.
7. Deepest cores ever taken: last one from 20,463-503 feet.
8. Deepest formation test ever made: deepest made in open hole interval between 19,765 and 20,521 feet, with packer set at 19,718 feet.
9. Deepest cementing job ever performed: seven-inch shoe set at 19,765 feet.
10. Most severe winter in 50 years failed to stop drilling operations.
11. Greatest depth, 20,521 feet, to which electric log and other instruments have been lowered in a well.

By GILBERT M. WILSON
Pacific Coast District Editor

A WELL reaching the record depth of 20,521 feet, a scant 600 feet short of four miles, and representing the third consecutive time in as many years that the depth record has been broken by the same company, is the latest achievement of The Superior Oil Company. The Pacific Creek Unit 1, wildcat in southeastern Sublette County, Wyoming, has again demonstrated what can be done with a closely-knit combination of adequate equipment, good drilling practices, close attention to equipment maintenance, and skill of all personnel on the job.

In a period of about 10½ months, which included one of the most severe winters in Wyoming's history, the company reopened an old hole drilled the previous year to a depth of 9881 feet, and carried it to the present total depth of 20,521 feet. Using the world's largest rig to break by 1787 feet the company's own three-months-old world record of 18,734 feet; setting a record-breaking, 19,765-foot string of seven-inch casing; and holding hole deviation to within only 1- to 1½ degrees off vertical, are but a few of the highlights that make this one of the most interesting drilling projects in recent years.

Located in 27-27n-103w, about 22



RIGHT: View looking up inside the derrick showing extra heavy swivel, elevators, links, connector and the six-sheave, 540-ton capacity travelling block. Sheaves in both the travelling block and the seven-sheave, 630-ton capacity crown block are 60 inches in diameter. Three-inch by 55-foot long rubber rotary hose was used down to 10,000 feet, after which two 4½-inch by 55-foot steel hoses were installed. Because of the unusually high derrick, two wire line guides (right) and three deadline stabilizers (left) were used.

BELOW: Taken while the record-length string of seven-inch casing was being run in, this view shows crew moving casing toward walkway while bulk cementing units stand by near derrick just beyond pipe rack. Note 19,765-foot string of drill pipe, in thribbles, standing in derrick.

Photo Courtesy The National Supply Company

miles east and north of Farson, which is about 42 miles north of Rock Springs, the well is near the center of a broad, gently rolling plateau on the western slope of the Continental Divide, 7000 feet above sea level.

Using a contract drilling rig, the company first spudded in July 13, 1947, with nine-inch hole and drilled to 1062 feet. After reaming to 17¼-inch, a string of 13⅜-inch casing was cemented at 1000 feet. Nine-inch hole was carried to 9881 feet, where operations were suspended November 11, 1947. Coring at various points in the hole and a formation test at 7360-82 feet had failed to reveal commercial shows of oil or gas.

Big Rig Moved in

On June 28, 1948, the company moved in its 20,000-foot rig which had been on view a month earlier at the International Petroleum Exposition at Tulsa. On July 27, a month after the new rig was set up over the old hole, cement plugs were drilled out and work was commenced cleaning out to bottom and reaming the nine-inch hole to 12¼-inch. Additional new hole was drilled to 9929 feet, after which a string of 9⅝-inch casing was run to bottom and cemented with 1500 sacks. No new formation tests were made in the hole down to this point.

Following a successful test of water shutoff at the shoe of the 9⅝-inch casing, drilling was resumed, with 8¾-inch hole being carried from there to 19,765 feet. A few fishing jobs, involving for the greater part twistoffs and recovery of lost cones, occurred in this interval, but in each instance the fish was recovered successfully. Seven formation tests (see Table 1), none of which yielded more than gas or gas-cut mud, were made at various points in open hole down to 13,287 feet. From the shoe of the seven-inch casing at 19,765 feet to total depth of 20,521 feet, 5⅞-inch hole was drilled. Weak blows of gas and gas-cut mud resulted from the two formation tests made in this interval shortly after total depth was reached.

From July 1 to July 17, six formation tests were made, these being concentrated in the 13,830 to 17,485 interval behind the seven-inch casing. Tests were made through jet-perforated holes, the latter shot at a frequency of four per foot. Weak gas blows and gas-cut mud, without oil shows, were the principal indications recovered in these tests. Additional tests were made at 7396 before the well was abandoned August 18.

Severe Winter

As can be seen by the progress of the drilling Depth-Time Curve, operations were slowed little or none during the most severe winter experienced in more than 50 years in Wyoming. At times temperatures dropped to 40 and 45 degrees below zero. Blizzards had road crews, as well as company-owned trucks and snow plow equipment, busy on a round-the-clock basis keeping roads open so men and supplies could be taken to and from the well. During one severe storm, one drilling crew worked continously for 24 hours in order to keep operations going until relief crews could break through snow-choked roads and reach the well.

Preparations for winter had been made well in advance. The entire rig, including drawworks, engines, mud pumps and mud tanks, was covered with a large sectional steel building. A boiler

was installed inside the building for heating purposes, and smaller heaters were put on the derrick floor. The derrick was partially enclosed, and steam heating coils were placed near vital parts of the drilling machinery.

Eight electric log runs were made, two while the contract rig was over the old hole, and six while the new rig was operating.

The well was spudded in in the Wasatch Formation of Lower Eocene age at elevation (KB) of 7090 feet. Fort Union-Lance, undifferentiated, was topped at 7600 feet, Lewis Shale at 10,740, Mesa Verde at 11,660, Blair at 15,265, Baxter Shale at 15,860, and the Frontier at 19,720. The bit still was in Frontier formation of Cretaceous age when total depth was reached at 20,521 feet.

Sands and Shales Drilled

From surface to total depth, formations penetrated generally were alternating sands and shales, with occasional streaks of conglomerate and lignite, the latter occurring in the lower Lewis shale and upper Mesa Verde. From surface to 4000 feet, cuttings showed predominantly sand with red and gray-green shale and sandstone. From 4000 to 9400 feet, formations were predominantly dark gray, black and brown shale with thin sand beds, and a few coal streaks. From there to total depth the bit passed through alternating sandstones and gray shale, with sandy shale and shaley sand.

Largest Rig

In a drilling project which has held the industry's attention over the past few months, and which requires for its description numerous such superlatives as "first," "largest" and "deepest," it is difficult to single out any one piece of equipment and say that it is the most important part of the project. It is safe to say, however, that the hoisting equipment, the largest in the world, has commanded a lion's share of the interest. The well marks the first time that drilling equipment has been designed and built expressly for use with 1½-inch wire line. The fact that this hoisting equipment, the derrick, engines, pumps and all other equipment on the well successfully withstood the punishment associated with drilling a hole nearly four miles deep, is an achievement that will throw much light on the possibilities of future deep drilling.

Adaptation of the design to 1½-inch line makes possible the handling of a 20,000-foot string of 4½-inch drillpipe or a five-inch string to 16,000 feet, with normal eight-line reeving. Twelve lines are required, and were used, in the setting of the string of seven-inch casing at 19,765 feet.

The drawworks drum is 36 inches in diameter by 61¼ inches long. These dimensions permit the hoisting of 135-foot stands of drill pipe with eight lines without having to spool more than three full layers on the drum, a feature which improves performance and reduces crushing of the line. The rig has six speeds available for hoisting, three from the selective transmission times the two available to the drum shaft. The rotary table also has six speeds, these being obtained by the three speeds available to the drawworks, times the two speeds in the rotary table transmission countershaft located within the drawworks housing. The cat shaft has three speeds, power being transmitted from the drawworks jack shaft to the jack shaft and from there to the cat shaft.

The drawworks is equipped with conventional band brake and an auxiliary dynamatic electric brake. The band brake is a new type, compound equalizing, air-operated water-cooled, the rims of which are 62 inches in diameter. Operation of this brake is made effortless by the use of compression springs which are used to apply the brake, and a compressed air-actuated device which releases the brake. A modulating type of air valve, convenient to the driller, makes it possible to control the heaviest loads with a minimum of effort.

An unusual feature of the 60-inch auxiliary electric brake is the manner in which it is automatically engaged or

TABLE 1

Record of Formation Tests

September 8, 1947, 7360-7382
On dry 4½-inch drill pipe. Recovered 6500 feet of mud with no showings of oil or gas. Safety joint leaked, accounting for rise.

September 25, 1948, 9914-10,222
4½-inch drill pipe with 1500 feet water cushion. Open 45 minutes. Recovered 45 feet mud. No shows.

October 16, 1948, 11,002-11,022
4½-inch drill pipe with 2000 feet water cushion. Open 45 minutes. Recovered 126 feet slightly gas-cut mud.

November 2, 1948, 11,614-11,690
4½-inch drill pipe with 2000 feet water cushion. Test failed.

November 5, 1948, 11,639-11,749
4½-inch drill pipe with 2000 feet water cushion. Opened, packer held for 15 minutes, then failed. Recovered 350 feet gas-cut mud, good odor.

November 17, 1948, 11,997-12,108
4½-inch drill pipe with 4000 feet water cushion. Open 30 minutes. Recovered 437 feet gas-cut mud. Gasoline odor.

December 1, 1948, 12,200-12,451
4½-inch drill pipe with 3530 feet water cushion. Open six minutes, then packers failed. Recovered 275 feet gas-cut mud.

December 24, 1948, 13,219-13,287
4½-inch drill pipe with 500 feet water cushion. Open 16 minutes, then packers failed. Recovered 3800 feet gas-cut mud.

June 19, 1949, 19,765-20,521
3½-inch drill pipe with 10,080 feet water cushion. Packer set at 19,705 with tail to 19,718 feet. (Hole open from shoe of 7-inch at 19,765 feet, to 20,521.) Valve open at intervals for 10½ hours. Weak blows. Recovered 7410 feet net rise gas-cut mud.

June 28, 1949, 19,765-20,521
Re-test of interval 19,765-20,521 feet. 3½-inch drill pipe with 8000 feet water cushion and 776 feet drillable alloy tail perforated from 20,441-20,481 feet. Valve open 8¾ hours. Weak blow. Recovered 6425 feet net rise water, muddy water, and gas-cut mud. Left 454 feet of tail pipe in hole.

July 1, 1949, 13,830-13,870
Jet perforated interval with four shots per foot. Magnesium retainer had been set at 19,745 feet. 3½-inch drill pipe with 2040 feet water cushion. Open 6-1/3 hours. Recovered 610 feet net rise of gas-cut mud. After test, above retainer was replaced by cast iron retainer.

July 4, 1949, 13,830-13,870
Re-test of same interval. 3½-inch drill pipe with 2040 feet water cushion. Open 5½ hours. Gas to surface in 40 minutes. Weak blow. Recovered 1320 feet net rise of gas-cut mud.

July 8, 1949, 14,505-14,540
Jet perforated (1-oz. shots) with four shots per foot. 3½-inch drill pipe with 2040 feet water cushion. Open two hours, 52 minutes. Gas to surface in 61 minutes. Weak blow. Recovered 8820 feet net rise of mud. Safety joint leaked, accounting for rise.

July 11, 1949, 15,660-15,720
Jet perforated with four shots per foot. 3½-inch drill pipe with 3000 feet water cushion. Open 13 hours. Gas to surface in 67 minutes. Fair volume. Recovered 2610 feet net rise of gas-cut mud. Previously, top of cement plug placed above retainer was found to be at 19,653.

July 14, 1949, 17,435-17,485
Jet perforated with four shots per foot. 3½-inch drill pipe with 3000 feet water cushion. Open 5 hours, 27 minutes. Weak blow. Recovered 2910 feet net rise of gas-cut mud.

July 17, 1949, 13,830-13,870; 14,505-14,540; 15,660-15,720; 17,435-17,485
With packer at 13,790 on dry 3½-inch drill pipe and 2½-inch tail to 15,694 feet, including perforations from 15,657 to 15,687. Open 5 hours, 50 minutes. Gas to surface in 44 minutes. Recovered 9329 feet rise of gas and gas-cut mud. No oil.

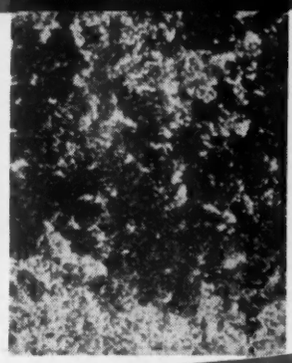
AMERICAN IRON DRILL COLLARS

STOP EXCESSIVE THREAD GALLING AND FAILURES

Photomicrograph of normal untreated machine thread

Microized thread shows penetration of micro film

Non-uniform structure that causes galling and failures



Uniform micro structure of steel in American Collars

AMERICAN IRON'S NEW MICROIZING PROCESS

Here's protection that stops excessive thread galling! American Iron's Microizing Process for drill collar threads applies a protective micro film which not only treats the thread surfaces but also penetrates into the surface pores of the steel (as shown above)! This prevents adhesion of the two threaded connections! That's why our Microizing Process gives positive protection against excessive thread galling!

HIGH ALLOY STEEL INSURES HIGHER IMPACT VALUES

Today's drill collars must have the very highest physical properties . . . properties that insure high impact values! That's why American Iron now uses a special high alloy steel to obtain a highly uniform micro structure (as shown above) from surface to thread areas. This fact, plus proper, full-length heat treating, results in the physical properties that insure high tensile and impact strengths in our drill collars.

ACCURATE BORING of circulation hole insures a well-balanced collar throughout—one that'll hold whip to a minimum. That's why our collars are precision bored to rigid API specifications on our hydraulically controlled Gun Boring Machines!

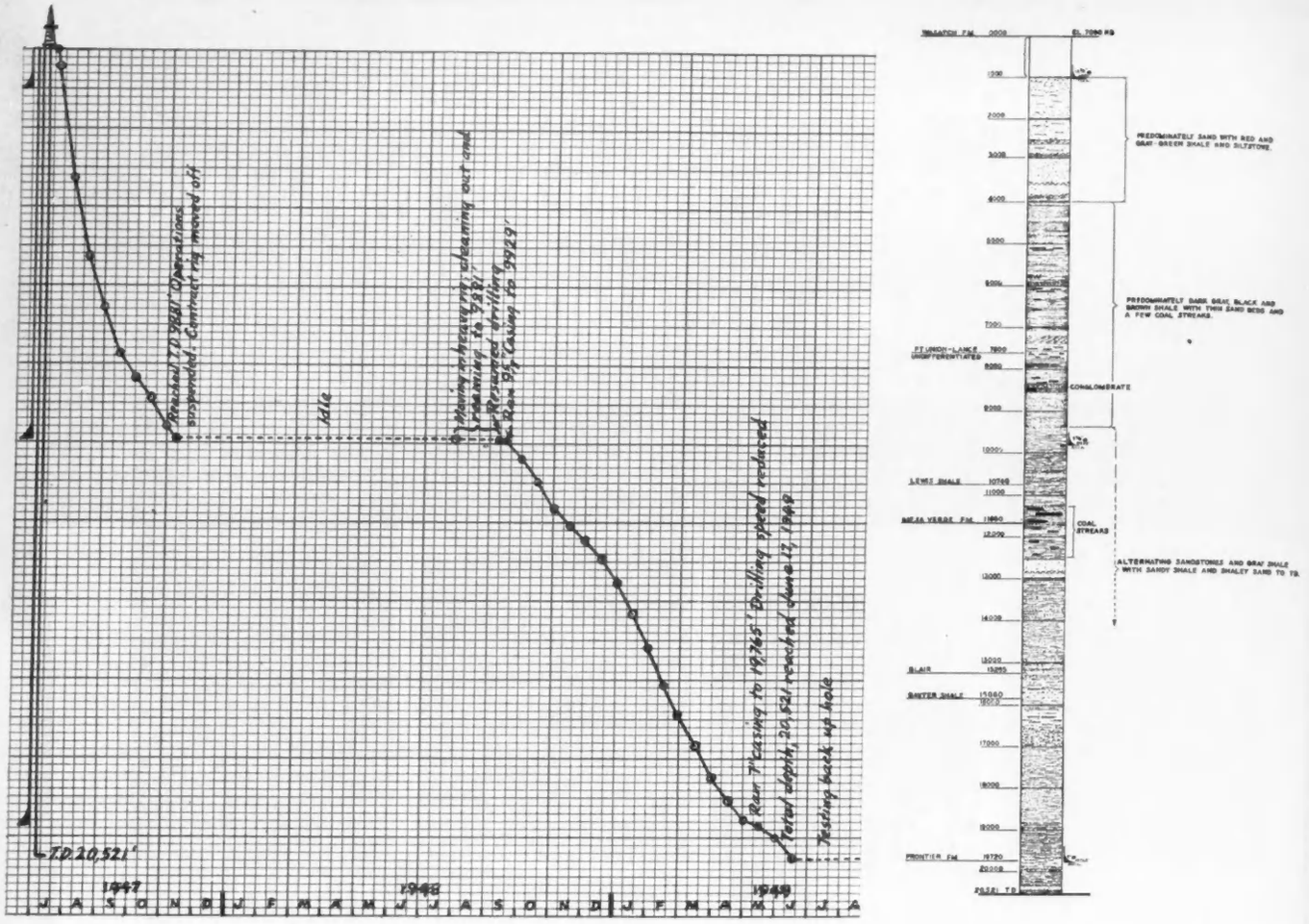
FULLY HEAT TREATED for longer wear! After forging and straightening, collars are heated to normalizing temperature; reheated for hardening quench; tempered for uniform structure; again reheated for straightening and stress relief.

REMEMBER, THERE IS AN AMERICAN IRON SERVICE MAN IN EVERY ACTIVE FIELD!

AMERICAN IRON & MACHINE WORKS CO.

Okla. City, Okla.—Box 1177—L. D. 518—Dist. Office: Houston, Tex.
Export Office: 11 West 42nd St., New York City, N. Y.

AMERICAN IRON & MACHINE WORKS CO. · A · OKLAHOMA CITY U.S.A.


T.D. 20,521'
1947
1948
1949
PREDOMINATELY SAND WITH RED AND GRAY-GREEN SHALE AND SILTSTONE.
PREDOMINATELY DARK GRAY, BLACK AND BROWN SHALE WITH THIN SAND BEDS AND A FEW COAL STREAKS.
CONGLOMERATE
COAL STREAKS
ALTERNATING SANDSTONES AND GRAY SHALE WITH SANDY SHALE AND SHALEY SAND TO TD.

Depth-Time curve of The Superior Oil Company's Pacific Creek Unit 1, Sublette County, Wyoming. Also shown are casing program and generalized geologic columnar section.

disengaged from the drawworks shaft. When loads of less than 65,000 pounds are being handled, the electric brake remains disengaged, the brake lever being handled in the conventional manner. When the load exceeds 65,000 pounds, however, an electric switch is actuated by means of a pressure diaphragm installed on the deadline a few feet above the deadline anchor, and the auxiliary brake then becomes operative, being controlled by actuation of the brake handle. This diaphragm-actuated switch, a new development for auxiliary brakes of this type, eliminates for the driller the necessity of throwing the brake handle nearly up to its maximum reach in order to cause the auxiliary brake to disengage.

The 42-inch low drum and the 36-inch high drum clutches are air-operated, as are also inertia brake and friction clutch for the rotary table. The two cathead clutches, individually operated, also are air-actuated.

The driller's control panel is conveniently arranged to provide positive and convenient control over all rig operations. Through the use of modulating type air control valves, the driller has available fingertip control for all speeds to the drawworks, rotary table, catheads, drum brake, inertia brake on the three speed transmission, rotary drive transmission, and engine throttles. Controls for reversing, selecting drilling range and for drilling control, are operated manually. Weight indicator, mud gauge tachometers and other instruments were arranged in conventional manner in front of the driller.

Automatic Feedoff Control

A new type precision automatic drilling control is being used on this rig. It provides for the driller a precision feedoff control which can be set at any desired feedoff rate merely by turning a small valve handle convenient to the driller's position. It provides any desired constant weight on the bit. Rate of penetration is indicated to the driller on a dial which is graduated from zero to 50 feet per hour. While in operation, the device provides a positive driving connection between the drum and the low speed drive, allowing the low speed friction clutch to remain inoperative during drilling operations. The hydraulic drive in the mechanism is driven from the rotary drive countershaft, so that when the table is stopped for any reason, the feed control automatically discontinues feeding off the drill string.

In drilling at the depths attained in this well, the problem of applying the proper torque and rate of feedoff is a delicate one, and the automatic control has given the driller an added measure of protection against the ever-present possibility of drill pipe twistoff. The more efficient rates of drilling also resulted in a marked saving in bits.

Crown and Travelling Blocks

The crown and travelling blocks on the rig are the largest ever used. Grooved for 1½-inch line, each has 60-inch sheaves and is designed to handle the maximum in casing and drill pipe loads. The crown block has a rated capacity of 630 tons, and the travelling block a rated capacity of 540 tons. They were designed to carry a string of seven-

12,500lbs.
Accurate Information under Pressure and Temperature
Again W.S.I. Radioactivity Well Logging instruments contributed essential information for the successful completion of a major exploratory project.
19,743 feet of hole was logged with W.S.I. instruments in Superior Oil Company's world's deepest well.

Radioactivity well logging service is available from these experienced licensees. . . .

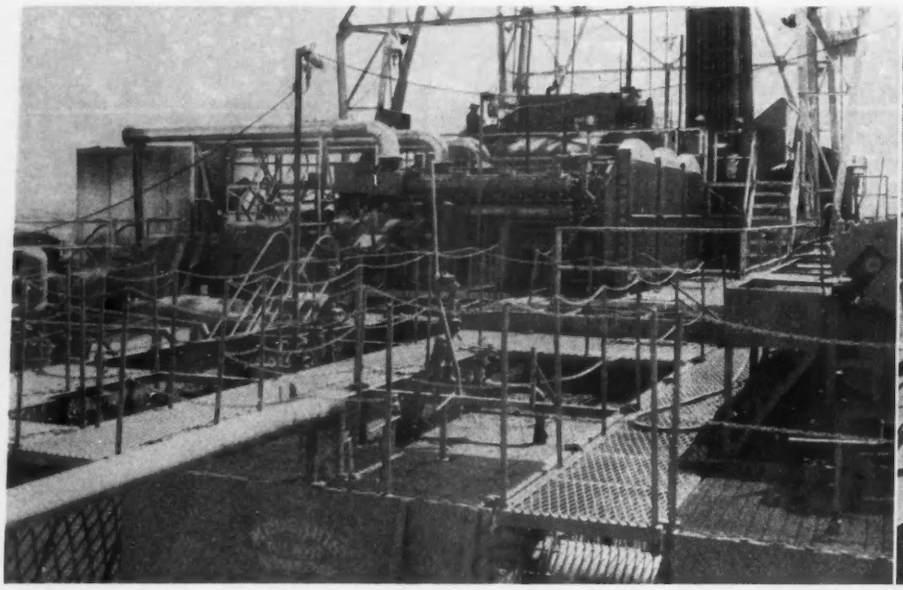
Well Surveys, Inc.

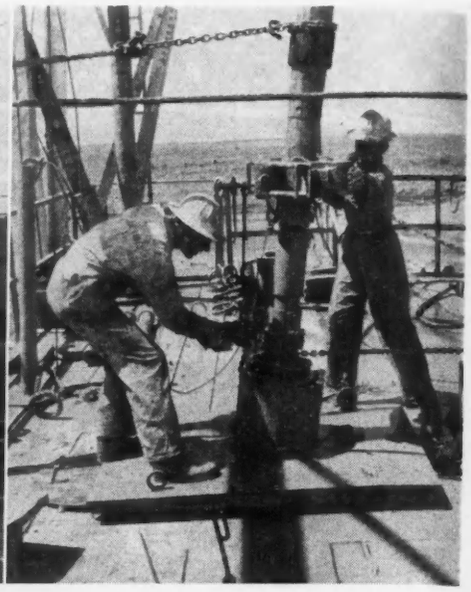
TULSA, OKLAHOMA U.S.A.

LANE-WELLS COMPANY
UNITED STATES – CANADA

SEISMOGRAPH SERVICE CORP.
of Delaware
CARACAS, VENEZUELA

GEOTECNICA, S. A.
BUENOS AIRES, ARGENTINA





LEFT: Taken before the area was covered with the sectional steel building, this view shows in the immediate foreground the steel mud suction tanks, and beyond, the three eight-cylinder, super-charged, diesel engines driving the drawworks and the two slush pumps. End of steel mud ditch, and shale shaker battery are partly visible at extreme right. Note safety features provided in generous use of wide, expanded metal walkways, and stanchion-supported chain guards surrounding tanks and hazardous areas.

RIGHT: Joints of drill pipe were added by stabbing the kelly into a joint previously set in a special spinning device mounted over the rat hole. Shown here is the kelly being made up on joint which rests in slips, the latter provided with extra long sleeves. While one man positions the back-up tongs on kelly, the other man guides spinning line (chain) which has been wrapped around extra long sleeves above slips. Located opposite the drawworks, the device easily is picked up and laid aside whenever kelly is to be lowered into the rat hole.

inch casing or 4½-inch drill pipe to a depth of 20,000 feet. Some idea of their size can be gained from the weights and size of their shafts. The crown block, less sand line sheave, weighs eight tons, and has a shaft 12½ inches in diameter. The travelling block, weighing just under 11 tons, has a shaft 10½ inches in diameter.

New Connector

A new design connector used on this well features a fully articulated equalizing connection to the travelling block with straight link suspension. Having a rated load capacity of 540 tons, the connector has a yoke member which is carried on a long, low-stressed spring, and which turns freely on a heavy duty tapered roller bearing when not locked against rotation. The yoke can be locked in any of eight positions. Weldless links 108 inches long are used between the connector and swivel.

The new type swivel employed has as its principal feature straight link suspension, this being obtained through the use of the connector type swivel bail consisting of two vertical links, a horizontal yoke and the elevator shank. The main bearing in the swivel has a diameter of 22¾ inches.

To 10,000 feet, a 3-inch by 55-foot rubber rotary hose was used. From there to bottom, two 4½-inch by 55-foot steel hoses were employed.

Although 1½-inch line has been used for years in other industries, notably mining and timbering, it never before has been used as a rotary drilling line. Line used on this well is 6x19, right lay, equalized, independent wire rope center; its weight is approximately 3½ pounds per foot, and it has a nominal breaking strength of 98.9 tons. Spools average 4000 to 4500 feet each.

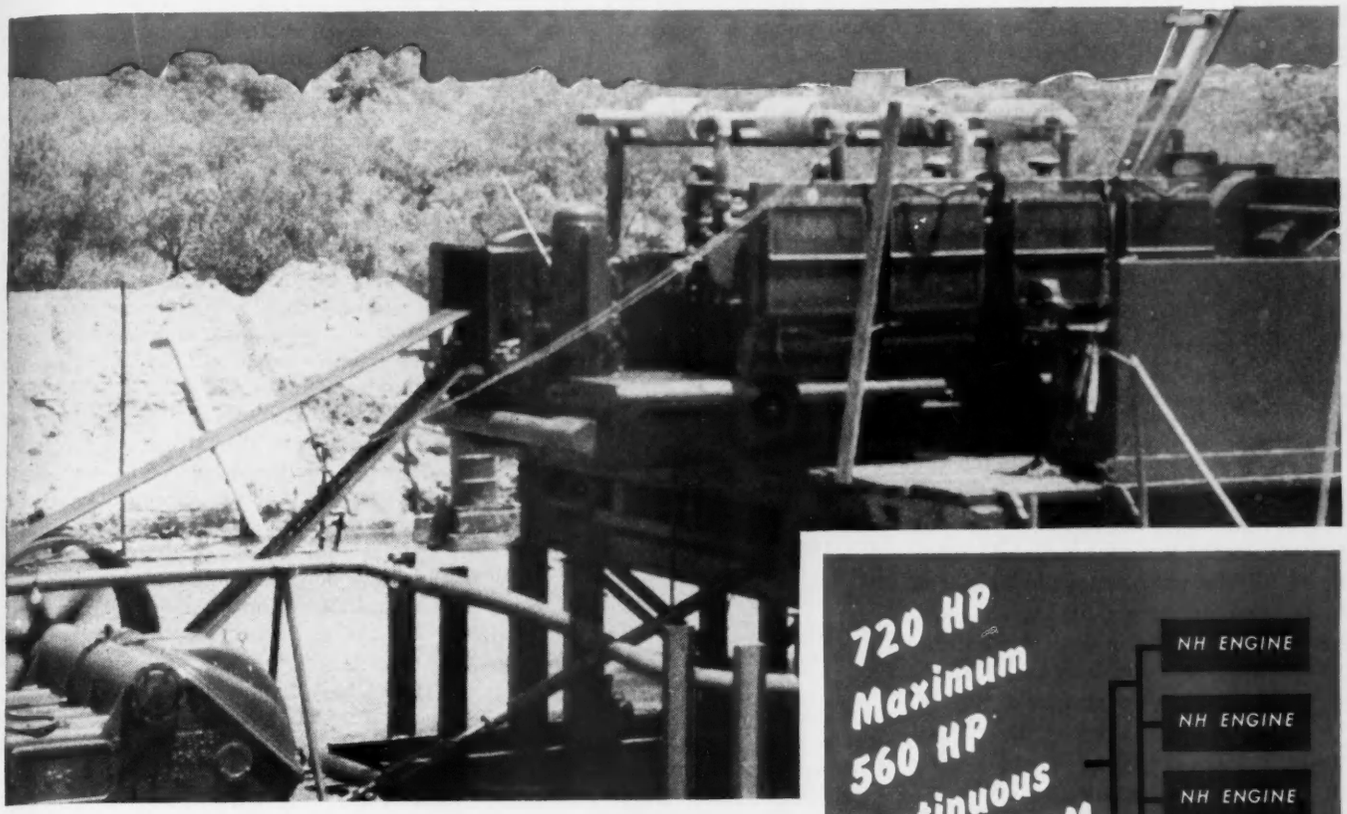
Despite the large size of the line, drillers report that the 1½-inch line spools as easily and with just as much freedom as do smaller diameter lines on lighter rigs. In drilling to 18,000 feet, eight lines were strung, ten lines being used from there down to casing point at 19,765 feet. As mentioned elsewhere, 12 lines were strung for running the seven-inch casing. The practice established by the company of frequently pulling over new line was rigidly adhered to on the well.

Shaft-Driven Rotary Table

The 20½-inch, high speed rotary table, designed to handle the heaviest loads to be encountered in 20,000-foot drilling, is shaft-driven through a separate two-speed transmission in the drawworks. When drilling, only the No. 1 engine generally is used to drive the rotary. Power from this engine, operating through the three-speed transmission, and in conjunction with the two-speed rotary transmission in the drawworks, combines to make available six basic speeds on the rotary table. The ability to choose table speeds independent of the speed the drawworks may be in at the time, plus the advantages inherent in the fluid drive couplings, combine to give a highly desirable, flexible operation of the rotary table.

Reaming Old Holes

An example of how the fluid drive feature was used to advantage is seen in the practice followed in reaming the old hole down to 9881 feet. It was found desirable to operate the table in a high speed gear ratio, with speed being reduced whenever necessary by slipping the No. 1 engine fluid coupling, thus limiting the power transmitted to the table. Whenever excessive torque built up due to presence of cave-ins in the hole or through a too-rapid accumulation of cuttings, the table would stall without danger of stalling the engine. Of heavy duty construction, the table has automatically induced oil bath lubrication and is completely sealed against mud and foreign material. On the average, down to about 18,000 feet, rotary table speed was held at around 100 revolutions per minute. Below that point, speed was held at about 50 revolutions per minute. Air-operated power slips



720 HP Maximum
560 HP Continuous
at 1800 RPM

NH ENGINE
NH ENGINE
NH ENGINE
NH ENGINE

Cummins "Dual NH" Power Units

have met every field test

"Operation highly successful. Cummins 'Dual NH' Power Units provide ample horsepower, quick acceleration, and very smooth operation." That was the report of R. C. Tucker, General Manager of George P. Livermore, Inc., when a Wilson Giant Torcair drilling rig powered with two Cummins "Dual NH" units completed its first well in Scurry County, Texas. This contractor has used Cummins Diesels since 1936.

Livermore, who standardizes on Cummins Diesels because of their economy and dependability, reports that the new Cummins units are ideal for oil field use. "Dual NH" Power Units furnish flexible power as needed . . . eliminate shock loads . . . have met every field test.

SEE YOUR CUMMINS DEALER

CUMMINS SALES & SERVICE, INC. . . . . . *General Office:* Mid-Continent Bldg., Fort Worth 2, Texas, Tel. 3-8785, 2-4485, LD-20
CUMMINS DIESEL SALES OF COLORADO COMPANY . . . . . 2450 Curtis Street, P. O. Box 507, Denver 5, Colorado, Tel. Acoma 5933
CUMMINS SERVICE & SALES . . . . . 1661 McGarry St., Los Angeles, California, Tel. Prospect 1026
CUMMINS DIESEL SALES OF MONTANA, INC. . . . . . 2211-13 Fourth Avenue, North, Billings, Montana, Tel. 8904
CUMMINS INTERMOUNTAIN DIESEL SALES COMPANY . . . . . 1030 Gale Street, Salt Lake City 11, Utah, Tel. 9-3768

were employed for the greater part of the drilling below 10,000 feet.

Supercharged Diesel Engines

Power for the rig is furnished by 5 eight-cylinder, dual fuel, supercharged diesel engines. Three of the engines supply power for drilling, including drawworks and the two rig pumps, and the other two units drive the auxiliary mud pump.

Each engine, at 900 revolutions per minute, is rated at 670 brake horsepower for hoisting, and 620 horsepower for continuous duty such as is required for slush pump and rotary table operation. Maximum output of the three rig engines, representing a combined capacity of 2010 horsepower, can be delivered to the two rig pumps, of 700- and 350-horsepower input respectively, to the rotary table, or to the drawworks. Much of the flexibility of operation of the rig comes from this ability to direct the entire power output to any of these three points when and if drilling conditions require it. The other two engines driving the 700-horsepower auxiliary slush pump are identical with the rig engines.

The depth record achieved by this drilling rig is all the more notable for the fact that this represents the first time that multi-cylinder engine power has been employed exclusively on a record-depth well. Each of the record breaking holes drilled since before the war has been steam powered.

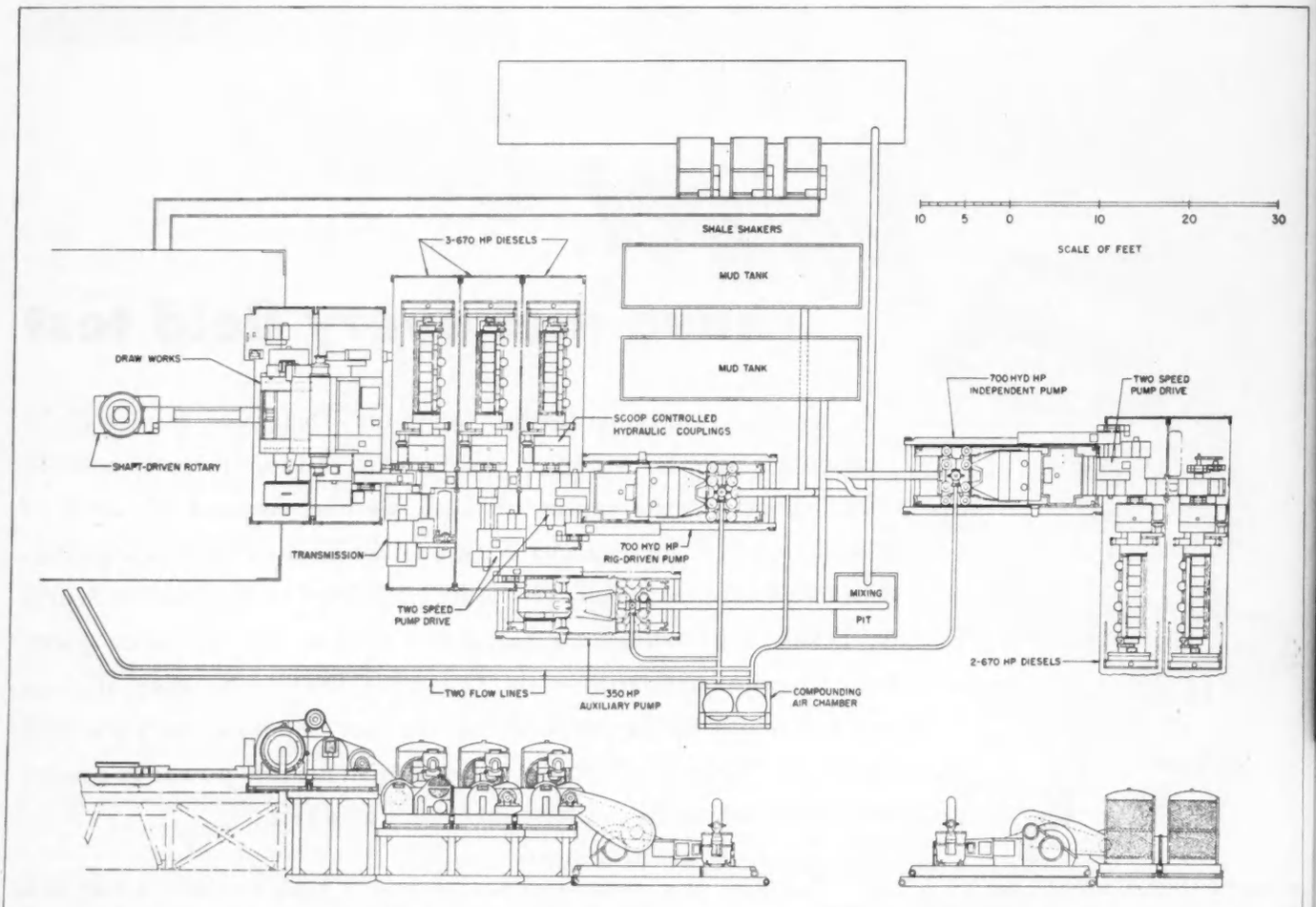
Fluid Drive Couplings

Fluid drive couplings, integrally connected with the drive shaft extension of each engine, have played a very important role and have contributed much to the successful operation of the rig. Drive from the engines to drawworks and pumps passes through these couplings, and by varying the engine speed and slip of the coupling, the latter feature being easily controllable by the driller, a wide range of power output to the shaft is available.

The fluid couplings provide a smooth, steady flow of power which is beneficial both to engines and to the driven equipment. The cushion eliminates harmful torsional vibrations from passing either way between the engine and the driven shaft. The amount of fluid in the drive coupling, a factor which governs the amount of power delivered to the output shaft, is regulated by a sliding scoop which in this particular installation is a new, air-operated type, easily controlled from the driller's position. This new type scoop is built into the engine extension shaft, and is a simple, compact arrangement. Function of the scoop is to regulate the amount of fluid in the coupling, and thus the corresponding degree of slip between the input and output shafts.

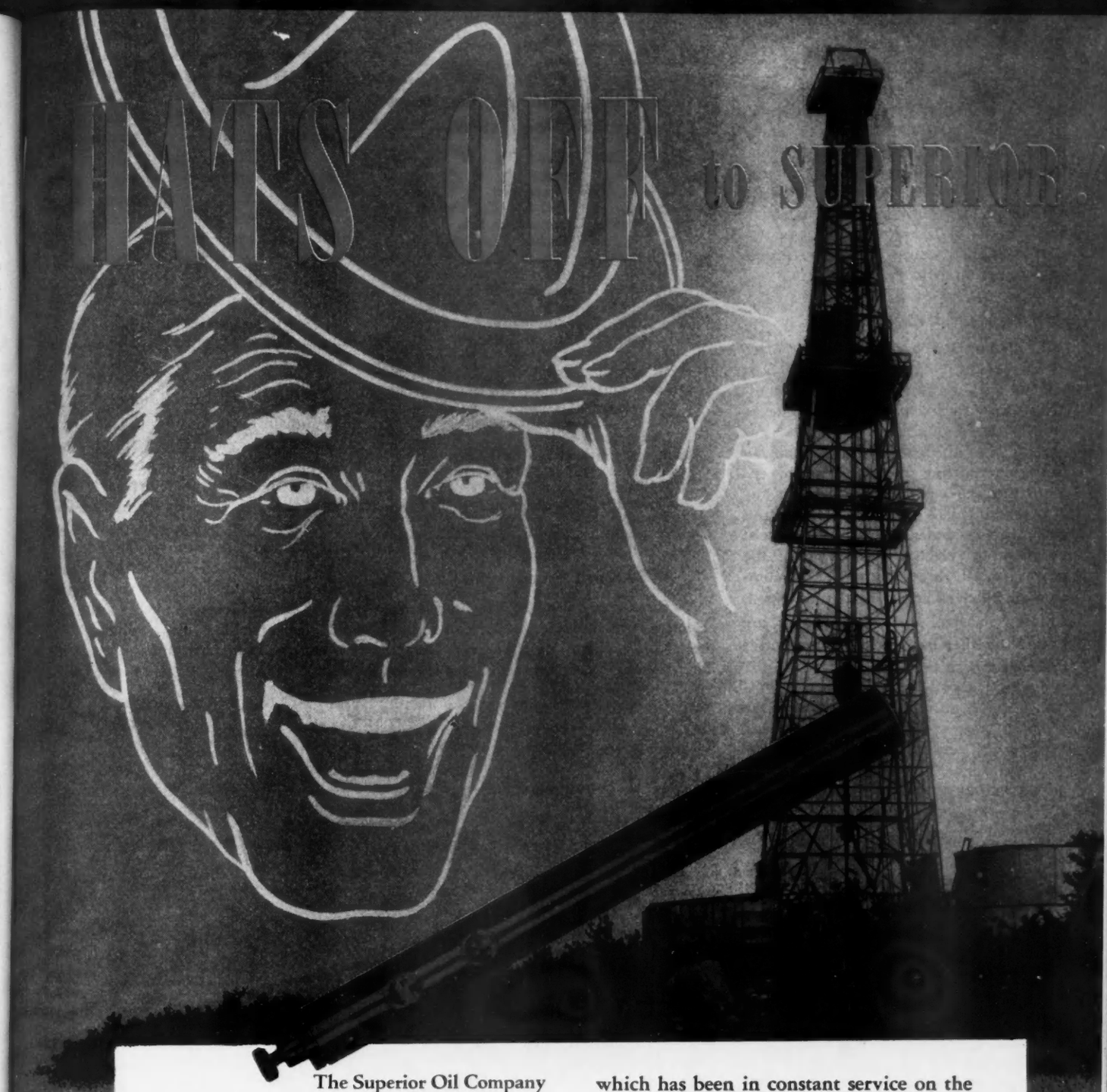
This ability to regulate slip permits the engine to operate at its optimum speed while the driven equipment slows down to suit the load requirement. Advantage of this feature is seen in the application to a slush pump drive where it may be desirable to apply full power to a stalled pump without risk of stalling the engine. Speed and ease of control of the sliding scoop enable the drive to respond quickly. The fast response, plus the fact that a complete cut-off of power can be accomplished, permits any engine to be cut off completely, eliminating the conventional friction clutch or power take-off.

In addition to those instances wherein



Scale drawing showing in schematic form the relative positions of all equipment used on the well.

Courtesy The National Supply Company



The Superior Oil Company has again broken its own world's deep-drilling record—with Unit #1, at Pacific Creek, Sublette County, Wyoming.

Three and a half miles down into the earth—and drilling still deeper—the straightness of the hole has been determined by the EXCLUSIVE use of the new type self-checking EASTMAN MECHANICAL DRIFT INDICATOR, which has been in constant service on the rig.

It takes skilled crews and rugged precision equipment to break records. EASTMAN takes pride in the fact that its MECHANICAL DRIFT INDICATOR, by securing perfect recordings at such great depth and at high temperatures, has had a part in the drilling of the world's deepest well.

Eastman

22 OFFICES FOR YOUR CONVENIENCE

OIL WELL SURVEY COMPANY

LONG BEACH • DENVER • HOUSTON

VENTURA • BAKERSFIELD

excessive loads caused the coupling to slip instead of stalling the engine, the fluid drive couplings contributed much to the ease and smoothness with which heavy loads were picked up. At the time the string of seven-inch casing was run in and cemented, for example, the 480,000-pound load shown on the indicator was handled with the ease and smoothness characteristic of steam-engine powered equipment.

Unitized Sections

Each unitized section of the drive group consists of the engine, which is aligned with, and connected to, its complementary shaft extension through the fluid drive coupling. Sprockets are mounted on the ends of the extension shafts, permitting the coupling of engines through a chain drive between the No. 1 and No. 2 shafts, and the No. 2 and No. 3 shafts. This arrangement permits the selective combining of the power of all three engines. The compounding drives are oil bath lubricated, running in steel enclosures which are bolted together between their respective drive group sections.

Calendar of Principal Events On World's Deepest Well

July 13, 1947: Spudded in with nine-inch hole with contract rig.

July 18, 1947: Cemented 13⅜-inch surface string at 1000 feet. Cleaned out and started drilling nine-inch hole.

Nov. 8, 1947: Reached total depth of 9881 feet. Operations suspended.

July 27, 1948: New 20,000-foot rig moved in. Old hole cleaned out and reamed to 12¼-inch.

Sept. 9, 1948: Started drilling new 12¼-inch hole. Drilled to 9929 feet.

Sept. 14, 1948: Cemented 9⅝-inch string of casing at 9929 feet. Cleaned out and started drilling 8⅜-inch hole.

May 14, 1949: With total depth at 19,765 feet, ran in and cemented string of 7-inch casing on bottom. Cleaned out and started drilling 5⅞-inch hole.

June 17, 1949: Reached total depth of 20,521 feet.

August 18, 1949: Abandoned.

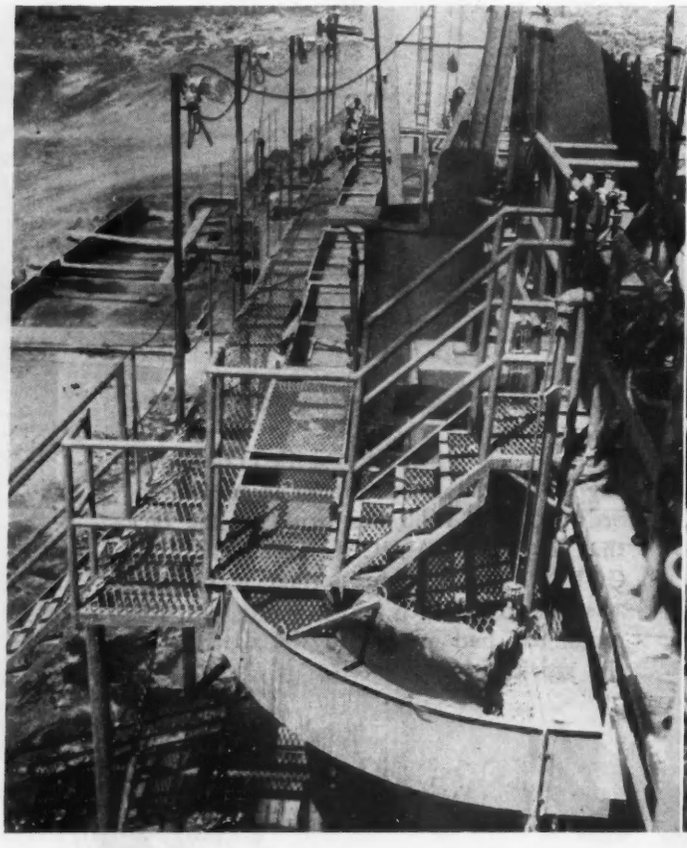
Selective Transmission

A three-speed, oil bath lubricated selective transmission is positioned on the No. 1 section of the drive group. The engine shaft extension serves as the primary or high speed shaft. Power of one, two, or all three engines may be directed through this transmission. While drilling, the No. 1 engine generally is used for driving the rotary table. Power from this engine, operating through the three speed transmission and two speed rotary transmission within the drawworks, delivers the six basic speeds to the rotary table. Availability of a low rotary speed obtainable through the transmission is convenient for breaking out or making up drill pipe while the drawworks remains in a higher hoisting speed.

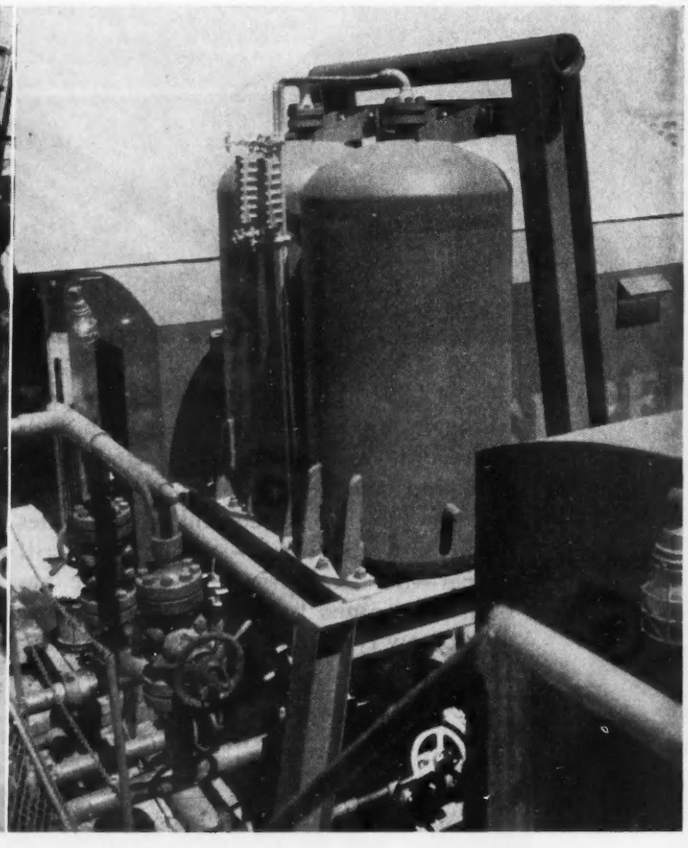
Six Speeds for Hoisting

For hoisting operations, the power of any or all three engines may be directed as required through the transmission, and from there to the short jack shaft at the rear of the drawworks. From there, power is delivered to the line shaft, then to the drum through either a low- or high-speed drum drive. A total of six speeds is available to the hoisting drum. Three different speeds to the cathead are provided by a chain drive between the line shaft and the cat shaft.

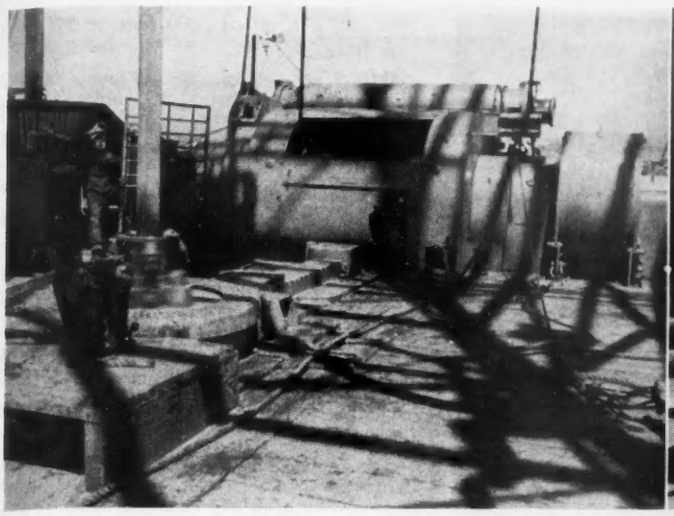
Air-operated clutches are used



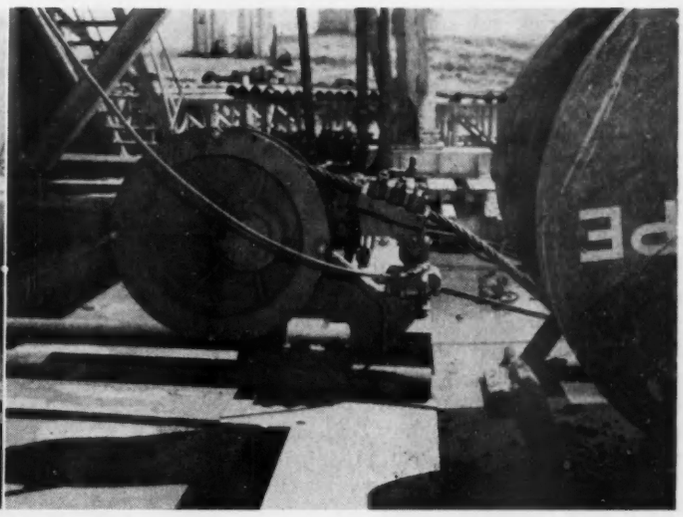
View from near derrick floor showing mud ditch and walkway layout. Steel ditch is 26 inches wide, 23 inches deep, and 56 feet long. A three-foot expanded metal walkway runs the full length of the ditch and is accessible from the derrick floor. The mud ditches and tanks were designed for easy assembling and breaking out. The ditch is adjustable in height and length.



Two compounding chambers, each 42 inches in diameter by 90 inches high, increase flexibility of mud pump operation. One chamber, located on line between the two rig pumps, compensates for cyclic volumetric difference between discharge of one pump and suction of the other. The other chamber is placed in high pressure discharge line to smooth and alleviate pressure fluctuations.



Outstanding features of the drawworks are the extra long drum grooved for 1½-inch line and the shaft-driven rotary table. Drum capacity is such that, with eight lines strung, the 135-foot drill pipe stands can be pulled without having to spool more than three full layers on the drum. Rotary table is driven through separate transmission within drawworks. This view was taken while reaming down to 9881 feet, and before air-operated automatic slips were installed.



Combination deadline anchor and weight indicator was used on the well. Mounted on the derrick sub-structure base, the device combines a narrow drum on which several wraps of the line are taken, and a lever to which is attached, through linkage, a hydraulic pressure-sensitive element. Load on hook is shown directly in pounds on driller's indicator instrument. Because of line wraps, only small amount of full line pull is transmitted to the line clamp.

throughout. In addition, air-operated, inertia-type brakes are provided in both the selective transmission and the rotary table transmission.

The inclusion of a two-speed drive to the pumps provides greatly improved flexibility of pump operation. The high speed can be used to maintain maximum circulation during normal drilling, while the low speed is available for developing abnormally high pressure or volume.

For portability, the three engines are mounted on reinforced, structural steel frames which can be assembled into a single operational unit. Each engine section conforms to the legal eight-foot road width limit.

Mud Pumps

As mentioned previously, the rig is equipped with three mud pumps, two of 700 and one of 350 nominal output hydraulic horsepower. Input horsepower is 825- and 495-horsepower, respectively. The larger pumps, one of which serves as a separately powered auxiliary unit, are designed to meet the requirements of 16,000- to 20,000-foot drilling. No mechanical lubrication is required, oil being delivered to the main gear, pinion and cross heads by means of a splash system. All roller bearings are grease packed and are lubricated from outside the pump. Bore and stroke of the large pumps is 8½x16, and of the smaller one, 7¾x18.

Two speeds are available to each pump, a factor which contributes much to the efficiency and flexibility of the installation. When maximum circulation is required, the high speed drive is selected. The low speed is used when high pressures or low volumes are required. The low speed also provides a means of increasing circulation pressures without reducing engine speed. While this may impose an overload condition on the pump, short time overloads, such as when a static load of fluid was moved, are permissible. Maximum working pressure recommended for the 700-horsepower unit is 3500 pounds per square inch. Availability of the low speed also eliminates the need for reducing pump liner sizes during emergency periods.

For the greater part of the drilling, the one 700-horsepower rig engine driven pump was used for circulating while the 350- and the auxiliary 700-horsepower units were used principally for mixing and conditioning mud. Careful attention to the mud and maintaining of an adequate volume of mud circulation were given much credit for the consistently good footage obtained from rock bits at these extreme depths. The high pressures and volumes required in the last 1000 feet or so of hole were successfully handled by the pumps with an adequate margin of safety. From 19,000 to 19,765 feet, where casing was set, volumes of 200 to 300 gallons per minute at from 2300 to 2600 psi were typical of the pumping conditions at those depths. When the seven-inch casing was cemented, cementing truck units mixed cement, but the rig pumps were used to displace it. Final, and highest pressure attained by the pumps was 3400 pounds, recorded when the plugs bumped.

Compounding Chambers

Although some compounding of the pumps was carried on between 11,000 and 12,000 feet, by far the greater part of the hole was drilled with only the 700-horsepower rig pump. Available at the well, but used principally as pulsation dampeners, are two high pressure compounding chambers. These chambers, built to withstand 2500 psi, are cylindrical in shape and measure 42 inches in outside diameter by 90 inches high. They are mounted side by side on a special steel H-beam unitized base which permits easy loading and setting up. One of the chambers is tied in between the two pumps to compensate for cyclic difference between the discharge of one pump and the suction of the other. The other chamber is connected into the high pressure discharge line to smooth out pressure fluctuations. Fluid level sight gauges are connected into outside lines near the top of the chambers.

Derrick and Sub-structure

The heavy duty derrick used on the well is 192 feet high, measured up the leg, from base plate to top plate. Actually, it is about three feet higher because of the built-up steel grillage on which the legs stand. At floor level, the base is 37 feet, 9⅝ inches square. Designed for a lifting capacity of 550 tons, the derrick is capable of withstanding a 125-mile per hour wind load. The gin pole has a lifting capacity of 20,000 pounds, and has a clearance of 16 feet above the headers. Water table opening is nine feet across.

An unusually sturdy sub-structure is employed on this rig. Combining great strength with sectionalizing to facilitate transporting and assembly, the sub-structure consists of two main parts:

(1) the derrick sub-structure which is independent of the derrick, and (2) the drawworks support, which is independent of the derrick sub-structure. Constructed primarily of H-beam and I-beam structural steel beams, the various units are assembled by means of tapered steel pins. The derrick legs are bolted to grillage units made of heavy H-beam material, the grillage providing proper distribution of loads on the reinforced concrete mat. Diagonals provide internal bracing of the substructure as well as the derrick floor overhang. Sub-structure posts are positioned to support most efficiently the rotary table and drill pipe loads. Measuring 13 feet, 3 inches high, the sub-structure assures ample head room for blowout preventer equipment. The drawworks equipment supports are heavy, welded, skid-mounted units having over-all dimensions that are within the highway hauling limitations.

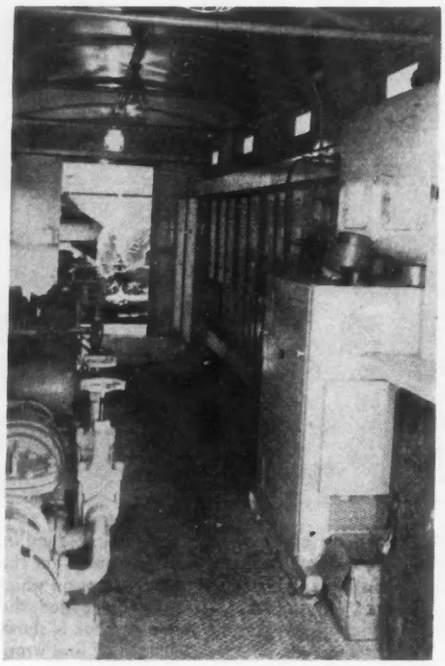
Rig Winterized

To protect men and equipment from the severe winter, the rig equipment was almost completely covered and winterized. A large sectional steel building housed all drilling machinery, including drawworks, engines, pumps, most of the mud mixing control system and a heating boiler. The boiler, a 350-pound fuel oil unit, was operated at 100 psi and provided steam for the building and various heating coils placed near rig machinery. Protective sheeting also was installed around the derrick, one section extending from the ground up to the second girt, and another section surrounding the derrickman's position.

Mud Control System

The mud control system includes three steel mud suction tanks, each 6 feet high, 7 feet, 9 inches wide, and 30 feet long. The tanks, mounted three feet apart and parallel to each other, are separated by three-foot wide expanded metal walkways. Three shale shakers are mounted side by side on the first tank, with a flow ditch from the shakers to all three tanks as well as to the sump. Each tank is equipped with two suction valves and two lever-operated dump gates. All three tanks are connected with 20-inch levelling lines and have ten-inch pump manifolding connections. A steel mud ditch 26 inches wide, 23 inches deep, and 56 feet long, extends from near the well head to the shaker troughs. It is adjustable in length as well as height. A three-foot steel walkway extends the full length of the ditch and is accessible from the derrick floor. Total capacity of the trough and three tanks is 465 barrels.

Throughout the drilling of the well, clay-base mud, with some weight materials added near bottom, was used for circulating. At various points in the hole, certain additives, including caustic, quebracho, sodium silicate and some phosphates were added to the mud system. A pH value of about 8.5 was maintained during most of the drilling. In general, mud weight was held between 14.0 and 14.5 pounds weight during the drilling of the lower portion of the hole. Ten-pound mud was used in drilling the first 10,000 feet of hole. Viscosities ranging from 55 to 68 seconds were held, the higher values being maintained during the last approximately 1000 feet of hole. Sand content of the mud was held to less than 1 percent most of the time. Filter cake was maintained at 2/32-inch and water loss was held between the values of 3.4 and 5.6 cc.



Motor-driven air compressors, circulating pumps and neatly installed switch panels are contained in this all-welded, steel house. Skid-mounted, the house is eight feet wide by 28 feet long. Small windows near roof line admit light when doors are closed in bad weather.

Drill Pipe Program

The drill pipe program, described in detail, Table 2, was for the greater part conventional. Down to 16,171 feet, 4½-inch drill pipe was used. At this point, 7000 feet of the 4½-inch was removed and replaced by five-inch, after which drilling continued to 16,883 feet. At this depth, a five-inch pin failed, causing a fishing job, and after fish was recovered, the five-inch was laid down and replaced by 4½-inch. From 17,717 to 19,765 feet, a tapered string was made up, and about 4100 feet of 3½-inch drill pipe was added at the lower end of the 4½-inch. By the time 19,765 feet had been reached, a total of 5300 feet of 3½-inch had been added.

After seven-inch casing was landed and cemented, the 4½-inch was laid down and the remainder of the string made up with 3½-inch drill pipe. Following the drilling out of the cement plug, 19,700 feet of the 3½-inch was kept in the string and the balance made up with 2⅞-inch drill pipe. The 3½-inch was at all times kept inside the shoe of the seven-inch at 19,765 feet.

From surface to 19,765 feet, 391 feet of 6⅛-inch outside diameter drill collars were carried in the string. From there to bottom, 240 feet of four-inch O.D. collars were carried. Drill pipe protectors, one to each joint, were used throughout the drilling. All drilling was done with a 4½-inch by 54-foot hexagonal kelly. Drill pipe was plastic coated in an effort to reduce corrosion as much as possible.

A combination bumper sub and safety joint was carried in the drill string just above the drill collars. Of a maximum outside diameter no greater than the

Table 2
Drill Pipe Program

DESCRIPTION OF DRILL PIPE:

Surface to 16,171

4½-inch O.D., 18.10-pound, seamless Grade E, Range 3, external upset, internal flush, shrink thread. Equipped with 4½-by 20-inch, 6¼-inch O.D. internal flush, single seal, shrink-thread tool joints. Drill Collars Used: 391 feet of 6⅛-inch O.D. drill collars. Nine Range 3 joints.

16,171 to 16,883

Removed some of the 4½-inch and added 7000 feet of 5-inch O.D., Grade 4340 drill pipe in four stages to lower end of string. Failure of 5-inch pin at 16,883 feet occurred, causing 2309 feet of 5-inch plus drill collars to drop to bottom, falling some 5000 feet. Drill pipe and collars recovered. Drill Collars Used: 391 feet of 6⅛-inch O.D. drill collars. Nine Range 3 joints.

16,883 to 17,717

The 5-inch O.D. drill pipe was laid down, and enough 4½-inch drill pipe of same description as remainder of string, was picked up to reach bottom. Drilling 8¾-inch hole. Drill Collars Used: 391 feet of 6⅛-inch O.D. drill collars. Nine Range 3 joints.

17,717 to 19,765

At 17,717 feet, 4100 feet of 3½-inch O.D., 15.50-pound, seamless, Grade E (4340), EUIF, Range 2 drill pipe, equipped with 4¾-inch O.D. twin pin tool joints, was added above drill collars. By the time depth of 19,765 feet had been reached, a total of 5300 feet of the 3½-inch drill pipe had been added. Still drilling 8¾-inch hole. Drill Collars Used: 391 feet of 6⅛-inch O.D. drill collars. Nine Range 3 joints.

19,765 to 20,521

The 4½-inch drill pipe was laid down and balance of string made up with 3½-inch drill pipe. After cement plug was drilled out, 19,700 feet of the 3½-inch was retained and balance of string made up with 2⅞-inch, 10.40-pound, Grade E, Range 2 drill pipe equipped with IF twin pin tool joints. Bottom of 3½-inch kept inside 7-inch casing shoe at all times. Drilled 5⅞-inch hole. Drill Collars Used: 240 feet of 4-inch O.D. drill collars. Eight Range 2 joints.

22nd ~~1~~st CONSECUTIVE WORLD RECORD WELL!

The Martin-Decker Weight Indicator on Superior Oil Co.'s Unit 1—SW NE SW 27-27N-103W, Sublette County, Wyoming, Completed at 20,521 feet August 18, 1949.

MARTIN-DECKER drilling control instruments have the PROVEN DEPENDABILITY

The Ruggedness . . . The Accuracy . . . The Capacity . . . The Sensitivity . . . That Assures Safe, Efficient Performance Under Every Drilling Condition.

HOME OF THE WEIGHT INDICATOR

MARTIN DECKER CORP.

LONG BEACH, CALIFORNIA

SAN JOAQUIN VALLEY: T. J. CULLEN, BAKERSFIELD, CALIFORNIA
MID-CONTINENT DISTRIBUTOR: REED ROLLER BIT COMPANY, HOUSTON, TEXAS

drill pipe tool joints, this tool enables the driller to bump down repeatedly at any depth in order to free stuck drill collars or bit. If the string should remain stuck even after repeated bumping, the tool can be disengaged, permitting the drill pipe to be removed. By the action of the bumper sub, the driller can tell instantly whether the drill string is stuck above or below the joint.

Few Fishing Jobs

At the depth referred to above where a five-inch pin failed, the safety joint effectively proved its value. While running in with the drill string, and while still 5200 feet off bottom, the five-inch tool joint pin failed, dropping 2309 feet of five-inch O.D. drill pipe and 391 feet of drill collars and bit to bottom. Bottom at that time was 16,883 feet. The fish was engaged by a packoff type overshot and the bumper sub joint, still on the fish, was tripped repeatedly for several hours, but without being able to free the fish. The safety joint then was released, and the fish, minus the drill collars, was brought out of the hole. Following this, another string of drill pipe was made up which included additional drill collars, and the upper half, or female portion of the safety joint, and was run back in the hole. The safety joint was re-engaged successfully with the lower portion of the tool still on the fish, and after some jarring, the remainder of the fish was freed and removed from the hole.

This fishing job was the deepest and probably the most serious encountered in drilling the well. Several minor twist-offs occurred in a difficult portion of the hole between 10,200 and 11,600 feet. Failures occurred either in or just above the drill collars, but in each instance the fish was recovered successfully. At several points the loss of a cone or two occurred, but running of a junk basket or milling up the fish cleared the hole without serious difficulty or delay.

TABLE 3

Record of Bit Consumption* According to Depth and Hole Size

From To	Footage	No. Bits Used	Feet Per Bit	Size of Hole
Surface- 9929	9929†	110	90.26	9 and 12¼
9929-19,765	9836	189	52.04	8¾
19,765-20,521	756	19	39.79	5⅞

* Including Core Heads.

† Included reaming of 9-inch hole to 12¼-inch.

Bits and Coring Heads

Bit consumption in the well was considered good in view of the great depth drilled and the nature of the formations penetrated. Two important factors contributed to this satisfactory bit service: (1) the use of the automatic drill pipe feedoff device previously described; and (2) careful attention devoted to the mud and maintenance of an adequate volume of circulation.

Referring to Table 3, which shows a breakdown of the bits consumed according to depth and size of the hole, it is seen that bit consumption ranged from about 90 feet of hole per bit down to 9929 feet, to a consumption rate of slightly under 40 feet per bit in the last 756 feet of hole.

Hole opener bits, used principally in the top 9881 feet of hole, and core heads are included in these figures. Both conventional hard formation coring equipment and diamond core heads were used for coring. Eight cores were taken down to 9861 feet; 20, including six diamond cores, were taken down to 19,765 feet; and 4, all diamond cores, were recovered between there and bottom. Diamond cores were taken with a 5⅞-inch diamond core head.

Over-all core recovery, based on the 32 cores taken between 6530 and 20,503 feet, averaged slightly more than 85 percent. Diamond coring, which was started at around 19,000 feet, resulted in a recovery of slightly more than 97 percent. In the five cores taken between 19,743-20,503 feet, recovery was 100 percent. A 50-foot core, the longest taken in the well, was recovered from the interval 19,561-611 feet. Table 4 gives core recovery data according to depth, interval cored, and amount of recovery, together with a description of the individual cores.

Blowout Preventer Equipment

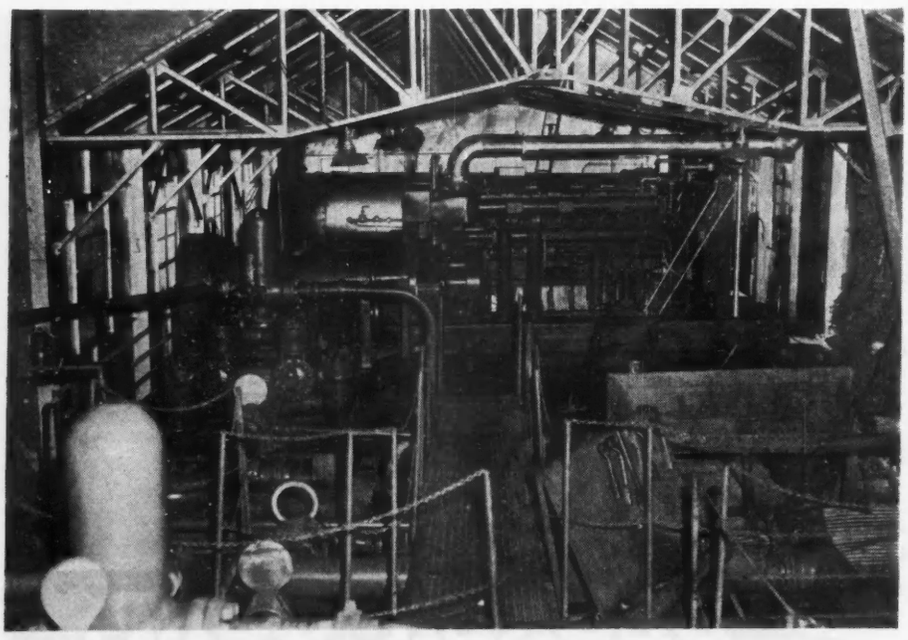
While drilling to 19,765 feet, the well was equipped with two 13⅜-inch blowout preventers. The lower one, a double-ram, hydraulically operated unit, is of a new type. Height of the unit is 30 inches, width is 40 inches, and length 89½ inches. Ram change is accomplished through hinged side opening doors. A unique feature of the preventer is that rams can be changed under field conditions in 30 minutes with pipe either in or out of the hole. Above this unit was a unit of the complete shutoff type. Accumulator and driller's control manifold were provided for each unit.

After the seven-inch casing had been set at 19,765 feet, three 6⅝-inch preventers were installed. The two lower ones were ram-type gates and the top one a complete shutoff unit.

Combination Indicator-Wire Line Anchor

In use on this well is a new type combination weight indicator and wire line anchor. Mounted on a base anchored to the derrick substructure at ground level outside the derrick, the device combines a narrow drum on which several wraps are taken of the line, and a lever for measuring the load on the wire line. Attached to the end of the lever is a linkage which is connected to a hydraulic pressure element, the latter transmitting the force to a weight indicator instrument at the driller's position. The load on the hook is shown directly in pounds on this gauge.

The drum is spirally grooved to provide maximum contact surface for the wraps. The design of the anchor permits



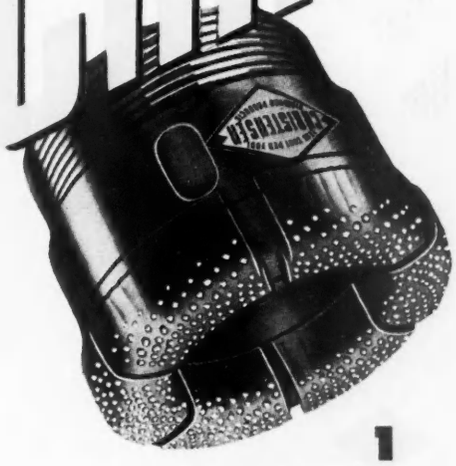
Taken from within steel building housing equipment during winter months, this view, looking north, shows position of the auxiliary 700-horsepower pump driven by two diesel engines of the type powering the drawworks. Partly visible at rear is the 350-pound fuel-oil fired boiler used for heating purposes.

Photo Courtesy The National Supply Company

ONE NAME
THREE SERVICES

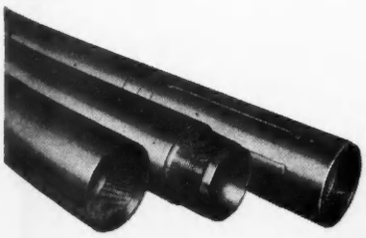
CHRISTENSEN

Three vital services to the oil drilling industry from a single source



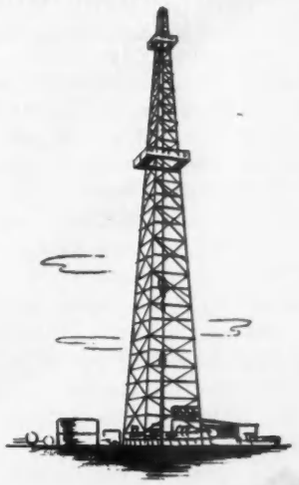
1
DIAMOND CORE BITS

The bits that have brought faster drilling, greater core recovery, less cost per foot.



2
CORE BARRELS

A product standard as high as Christensen diamond bits . . . barrels for rental or sale to provide a perfect team with Christensen bits.



FIELD SERVICE 3

Wherever Christensen products are used, trained field engineers are available.

Base Points

Purcell — Hobbs — Shreveport — Casper — Worland

Complete Service
Less Cost Per Foot

LESS COST PER FOOT
CHRISTENSEN
DIAMOND PRODUCTS

CHRISTENSEN DIAMOND PRODUCTS COMPANY

1975 SOUTH 2ND WEST • PHONE 6-8738 • SALT LAKE CITY, UTAH

the line to be moved around the drum without danger of kinking or creating sharp bends. When three turns are taken around the drum, the coil-braking effect is sufficient to cause only a small amount of the full line pull to be transmitted to the line clamp. The drum and base are heavy steel castings. Positive anchoring of the line is assured even when the pressure transformer element is removed for servicing. Automatic stops cast in the anchor drum flanges prevent rotation of the drums. Advantages of this device include simplification of installation, the line being pulled over without having to move the pressure transformer; extreme sensitivity, pressure in the transformer being very little affected by change in wire line size; and the fact that the pressure element cannot be affected by whip of the dead line.

Fast Casing Job

Running in and cementing of the longest string of casing ever run was a routine job handled speedily and without mishap. Twelve lines were strung, and all three rig pumps, the two 700- and the single 350-horsepower units were readied for the pumping job. Cement was mixed by three cement trucks set up beside the well. The seven-inch O.D. casing string, consisting of 497 joints of Range 3, Grade 4340 pipe was run in. Table 5 gives a summary of the casing strings used in the well, together with a breakdown of the various weights of pipe used in this longest string.

An extra heavy, automatic grip casing elevator and spider was employed for the job. Having a rated working load of 400 tons, the elevator has extra long slips which provide greater grip area. One man can operate the slip setting and releasing mechanism. The spider rests upon a structural steel subbase which is set in the same place as the rotary table when the latter is removed. The casing string was equipped with a float shoe on bottom and a float collar about 80 feet above the shoe.

Twenty-three hours were required to run the pipe to bottom at 19,765 feet. One thousand sacks of high temperature cement was then mixed and displaced. Mixing required about 30 minutes, and displacing of the cement required an additional 63½ minutes. During the pumping job, rig engines and pumps were operated at full speed. Final pressure, when plugs bumped, was 3400 psi. The casing was free at all times during the cementing process. When the string was picked up after cementing, the weight indicator showed 480,000 pounds. The string was landed in a 9⅝- by 7-inch casing head.

Temperatures encountered in the well

TABLE 4

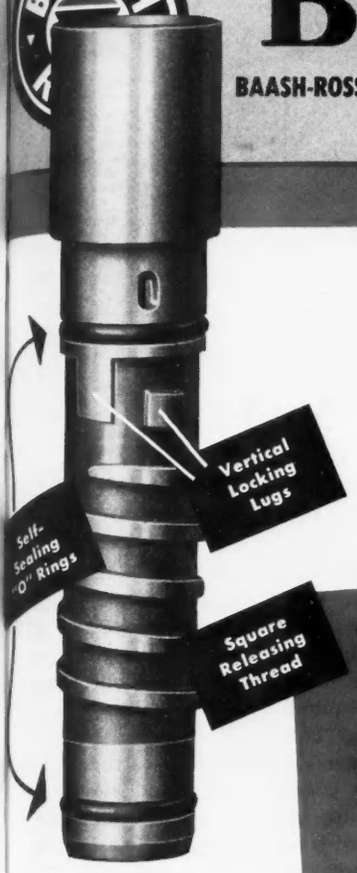
Tabulation of Cores Taken in Pacific Creek Unit No. 1. The last ten cores were taken with diamond core head.

From – To	Cored Interval	Recovery	
6530- 6541	11	17″	9″ Shale. 8″ Hard grey sand.
6628- 6646	18	17′ 9″	1′ 5″ Grey sand, fine-clayey. 4′ 7″ Shale. 11′ 9″ Grey sand, fine-clayey.
7383- 7401	18	16′ 9″	4″ Salt and pepper sand, fine-very coarse clay cemented. 12′ 9″ As above but finely conglomerate in places.
7760- 7778	18	15′	4′ 3″ Grey silty shale, coarse angular sand grains. 1′ Grey sand. 1′ Carbonaceous shale. 2′ 6″ Sand as above with carbonaceous inclusions. 2′ Grey shale, plant remains. 3′ Hard grey sand. 4′ Grey shale as above.
8345- 8360	15	8′	2′ 4″ Coal. 8″ Sandy calcareous shale. 4″ Siltstone. 8″ Black calcareous shale. 7″ Brown fine clay cemented hard grey sand. 8″ Grey carbonaceous shale. 1′ 11″ Sand as above, slight odor and light cut. 6″ Black carbonaceous shale. 4″ Tan siltstone.
8862- 8873	11	3″	3″ Grey shale.
9806- 9819	13	12½′	3″ Dark grey shale. 2′ 6″ Grey salt and pepper, fine tight sand. 9′ 9″ As above, more silty and sandy.
9850- 9861	11	7′	4″ Dark grey shale. 3′ Grey silty shale. 8″ Grey salt and pepper sand. 3′ Hard grey shale.
12,712-12,726	14	0′	0′ No recovery.
12,726-12,734	8	6½′	6½′ Grey salt and pepper sand, fine-medium clay cemented, slight distillate odor at bottom.
13,248-13,268	20	17′	17′ Sand, brownish grey, fine, slight oil saturation. Poor-fair distillate odor, thin carbonaceous partings.
13,619-13,624	5	4′	32″ Brownish grey sand, fine-medium, tight, faint-fair odor. 16″ Hard brown shale.
13,684-12,694	10	10′	7′ 3″ Fine brownish grey hard tight sand, good stain, fair odor, no cut. 2′ 9″ Greyish brown shale.
13,854-13,874	20	19½′	19½′ Sand, fine-medium brownish grey, slight stain, faint odor, no cuts.
14,554-14,568	14	12½′	4′ 6″ Sand, white-brown, fine-medium, slight odor and stain. 8′ Brownish black shale.
14,755-14,767	12	8′ 9″	5′ 7″ Sand, grey, fine-tight, faint odor, stain, no cut. 3′ 2″ Brownish black shale.
15,764-15,784	20	14′ 6″	14′ 6″ Sand, white, salt and pepper, faint odor, no stain or cut, tight, medium grained.
15,863-15,880	17	17′	10′ 6″ Alternating sand and shale, grey, salt and pepper. Shale dark grey. 12″ Sand as above with thin shale partings. 6″ Shale. 7″ Sand, streaks shale. 4′ 5″ Shale, grey.
18,035-18,048	13	7′ 6″	7′ 6″ Dense black calcareous shale.
18,638-18,652	14	6′ 4″	6′ 4″ Shale, dark grey, slightly calcareous.
18,778-18,788	10	10′	10′ Alternating irregular bedded shale and sand with 1″ partings. Shale grey-black. Sand hard, tight, grey.
18,788-18,802	14	12′ 1″	12′ 1″ Shale-sand partings as above.
18,954-18,981	27	23′ 6″	23′ 6″ Dark greyish black dense shale. Slightly calcareous.
19,276-19,314	38	38′	38′ Dark greyish brown-black shale, dense shale, silty and sandy in parts.
19,435-19,473	38	33′	33′ Well indurated dark greyish brown black, slightly sandy calcareous shale, thin laminae fine sand.
19,561-19,611	50	50′	50′ Irregular bedded alternating siltstone and shale, partings paper thin to 1″ thick.
19,646-19,667	21	19′	19′ Same as above.
19,743-19,760	17	17′	17′ Dark greyish black well indurated slightly sandy shale.
19,881-19,910	29	29′	29′ Dark grey shale, thin grey silty partings.
20,384-20,410	26	26′	26′ Sand, white, few black grains, medium, grading to fine on bottom, few shale laminae, brown-black, scattered green grains.
20,420-20,453	33	33′	16′ Partly shaly sand and dark grey sandy shale. Sand fine-white, few black grains clay cemented. 4′ White sand with black grains, tight, clay cemented fine shale laminae. 9′ Sandy shale and shaly sand. 4′ Sand and sandy shale, irregular patches. Sand fine white clay cemented, hard.
20,463-20,503	40	40′	15″ White sand as above, no shows. 12′ 9″ Hard greyish brown black, very sandy shale, grading into: 26′ Grey brown black sandy micaceous shale, becoming less sandy in lower part.

Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA CITY • NEW YORK

OUR 29th YEAR

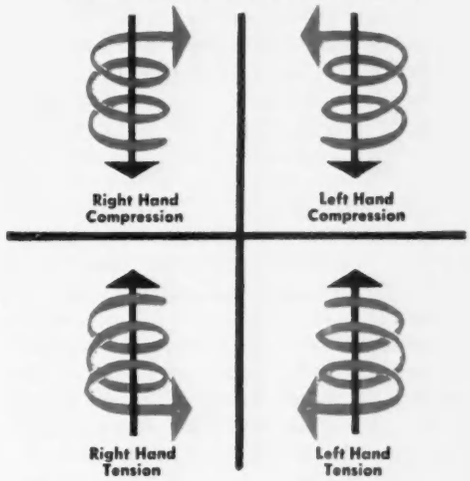


ANOTHER NEW BAASH-ROSS PRODUCT!

A simple, positive way to REMOVE STUCK TUBING STRINGS FROM YOUR PRODUCING WELLS

BAASH-ROSS PRODUCTION SAFETY JOINTS

4 TYPES TO MEET EVERY PRODUCTION REQUIREMENT



Why run the risk of costly salvage operations every time stuck packers, sanding conditions or similar difficulties jeopardize recovery of your tubing string, when it costs so little to insure recovery by using Baash-Ross Production Safety Joints?

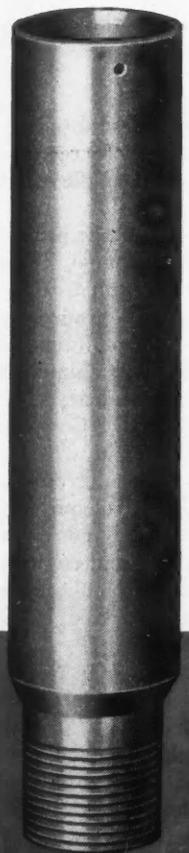
A Baash-Ross Production Safety Joint placed in your tubing string provides a positive means of freeing the string at the point where the Safety Joint is installed, thus permitting important savings to be made in production operations. For example . . .

▶ Where production packers are used, a Safety Joint should be installed above the packer to permit positive and complete release of the tubing string should the packer become stuck.

▶ Where sanding conditions exist, one or more Baash-Ross Production Safety Joints should be installed in the tubing string to permit selective release and maximum recovery.

▶ Where it may be desirable to change production methods in a well, a Baash-Ross Production Safety Joint should be installed in the tubing string to permit such changes to be made quickly and easily without disturbing the packer.

Baash-Ross Production Safety Joints are simple in design, positive in operation and low in cost. They are provided with a unique locking lug that permits heavy rotational loads to be transmitted through the Joint without loosening it—yet disengagement can be quickly made whenever desired by merely following a simple sequence of operations. A choice of *four* different releasing actions is available—either *left* or *right* hand rotation, combined with either *raising* or *lowering* the production string—thus providing the exact releasing action best suited to each production hook-up.



LEAK-PROOF SEAL . . . FULL OPENING PASSAGE

Note in the illustration how the Baash-Ross Production Safety Joint is packed off top and bottom with self-sealing "O" rings to permit circulation through the Joint without leakage. Also, the Joint is full-opening so that rods, tools and clean-out equipment can be passed without difficulty. In fact, the Joint has the same internal and external diameters as the production string itself. Anything that will pass through the tubing string will pass through the Joint . . . and the Joint itself will pass through anything the tubing couplings will pass through—an important consideration when used with certain types of suspensions.

A Size For Every Production Need

Baash-Ross Production Safety Joints are made of heat-treated alloy steel and are available in all four releasing actions to fit all sizes and types of API Tubing. So no matter what the nature of your particular production operations, you can protect against costly recovery or conversion operations by placing one of these efficient Joints on every tubing string.

QUICK POSITIVE RELEASE

Here's how the Baash-Ross Production Safety Joint operates to protect your tubing strings. The Joint consists essentially of a box and pin releasing thread (either right or left hand, as ordered) that is packed off top and bottom with self-sealing "O" rings. In the upper portion of the pin thread, two vertical lugs are machined into the body, and these lugs mate with a corresponding lug machined into the box portion.

The releasing threads are cut with a loose fit—that is, when the Joint is made up, the two portions can move a short distance longitudinally with respect to one another without affecting the vertical alignment of the Joint. This movement permits the mating lugs to lock and unlock as one portion of the Joint is moved with respect to the other portion—and the design of the lugs determines whether the Joint unlocks in tension or in compression. A shear pin is also provided that permits longitudinal movement of the Joint, but prevents premature rotational release.

Basically, the releasing action consists of first unlocking the lugs by lowering (or raising) the string—then rotating the string in the proper releasing direction (either right or left) to sever the shear pin and unscrew the Joint. Only by first moving the string in the proper vertical direction, then rotating it in the correct releasing direction, can the Joint be disengaged—and by properly selecting the releasing action, other tools below can be set and released without risk of disengaging the Joint.

were not excessive. Maximum recorded temperature, obtained when electric log was run to total depth of 20,521 feet, was 310° F. Mud ditch temperatures ranged from 100 to 125°.

For a hole of so great a depth, deviation from vertical was remarkably small. Data on the deviation, while not complete at the time of this writing, indicate that bottom of the hole is not more than one to 1½ degrees off vertical.

Contributing to the success with which deviation was held to so low a figure was the use on this well of a new type of mechanical drift indicator. More than 30 runs were made with the new instrument. Small for a mechanical type indicator, the instrument is seven-eighths-inch in diameter, 10 inches long and weighs only 12 ounces. The instrument is shock absorber mounted inside a barrel for running into the well. An important feature of the device is that it takes two successive recordings on every run. The self-checking feature is valuable in that it reveals whether any motion might have taken place during the recording period. If the two recordings do not agree, a re-run can be taken immediately. It was designed especially for use in high temperature wells where photographic paper is burned and batteries burst from excessive heat. The instrument, when mounted in the barrel, may be dropped down the drill pipe just before the string is pulled, to be recovered when the drill collars are broken down. Or, if desired, the device may be lowered on a wire line and recovered immediately after the test.

TABLE 5
Record of Casing Strings Set in Well

SIZE, O.D.	Weight per Foot	Type of Description	Set At	No. Sacks Cement
12⅜	54.5	J-55 T & C	1000 ft.	750 sacks
9⅝	47.0 and 53.5	N-80 Extreme Line	9929 ft.	1500 sacks
7	26, 29 and 32	SAE 4340, Extreme Line Range 3	19,765 ft.	1000 sacks

Other Equipment

Auxiliary equipment used on the well, for the greater part, was installed in skid-mounted, portable steel houses. Fabricated at the company's Rio Bravo, Calif., shops, these buildings included: (1) an 8x20-foot tool house; (2) an 8x28-foot generator house in which were mounted two 60-KW generators powered by 130-horsepower diesel engines; (3) an 8x28-foot compressor house containing two electric motor powered air compressors, circulating pumps and switch panel board; and (4) an 8x20-foot change house. A trailer house stationed near the rig served as quarters for the toolpusher.

Fuel and water tanks used on the well included one 300-barrel steel welded tank for boiler fuel oil; two 250-barrel welded diesel fuel tanks, three 1000-barrel steel bolted water tanks, and one 500-barrel steel water circulating tank. Water was obtained from shallow water wells drilled near the well.

Skilled Personnel

That the rig equipment was handled with skill and efficiency by the drilling crews is shown in some of the typical round trip times established while pulling and running drill pipe. While drilling at around 19,000 feet, with ten lines strung up, round trips of the 3½-inch drill pipe string were being made in from eight to nine hours, the time required to come out being about equal to that required to run back in. This is an average of 1.7 minutes per stand of 135 foot average, and includes time consumed in changing slips and elevators. Making up, running in and cementing the 19,765-foot string of casing in slightly more than 24 hours time also indicates the high degree of skill and coordination displayed by the rig personnel.

Following is a break-down (from top to bottom) of various weights of pipe used in 7-inch string:

No. Joints	Weight Lb./Ft.	Length
52	32	1989 feet
51	29	2009 feet
82	26	3279 feet
101	29	4041 feet
211	32	8447 feet
497		19,765 feet

Six-Man Crews

Four six-man crews were used for drilling. Including the relief crew and rig mechanic, 27 men were employed on the rig.

Those in direct charge of the project, including supervisory personnel, geologists and engineers were John C. Cody, vice president in charge of production; E. R. Barnett, drilling superintendent, Rocky Mountain area; J. D. Simmons, assistant drilling superintendent; C. T. Riley, drilling foreman; K. L. Gow, district geologist; Lealand M. Knapp, geologist; Howard N. Jensen, geologist; Donald E. Koch, chief petroleum engineer; Donald L. Bohannan, petroleum engineer; B. R. Edwards, mud engineer.

Drillers were Oscar A. Noble, Elgin F. Burns, John A. Rossetti, and Joe D. Herrington.

Derrickmen were Lloyd G. Benson, Earl L. Cantrell, Joe L. Childers, Melvin C. Goodgame, and Lewis W. Sparks.

Floormen were Duke Bosnich, Jack S. Catlett, Billy J. Coe, Sid B. Fullwood, Joseph H. Hible, Thomas H. Jordan, Otto L. Krause, Robert E. Lewis, Kefton E. McCready, William T. Morris, Samuel D. Sisk, Andy Stoffa, Nicholas Suhayda, Dominick D. Susic, Henry K. Webster, Wilbur C. Williams, and Jimmy Yardas.

Rig mechanic was Albert S. Thomas.

Examining 5⅛-inch diamond cores recovered from below 19,000 feet, are, left to right, Howard N. Jenson, geologist; E. R. Barnett, drilling superintendent, Rocky Mountain area; and C. T. Riley, drilling foreman on the well.

Photo Courtesy The Superior Oil Company

FRIO SANDS — ROCHE FIELD
REFUGIO COUNTY, TEXAS

Mud (Water & Clay) R_m = 0.75 ohm at BHT
Bit Size 10¾"
Spacings AM = 16"
AM' = 63"
AO = 24'

This is the first in a series of interpreted electrical logs from identified formations and fields which Schlumberger will reproduce in this publication. If you would like to keep this entire series, please write to us on your letterhead and we will be glad to send you a reprint of this log and a binder in which you may file subsequent logs as they are published. This series is made possible through the courtesy and cooperation of the oil operators who have released these logs.

1

LOG ANALYSIS

1) Water saturation S

R_O = 0.4 ohm in "X". This value will be used for "B" and "C" sands calculations.

In "B" Sand: $S = \sqrt{\frac{0.4}{29}} = 12\%$ approx.

In "C" Sand: $S = \sqrt{\frac{0.4}{12.5}} = 18\%$ approx.

2) Formation water resistivity R_w

$SP = -90 \log_{10} \frac{R_m}{R_w}$

At water level, in "X", SP = −115 mv.
thus, R_w = 0.04 ohm BHT

3) Porosity p

$F = \frac{R_o}{R_w} = \frac{0.4}{0.04} = 10$

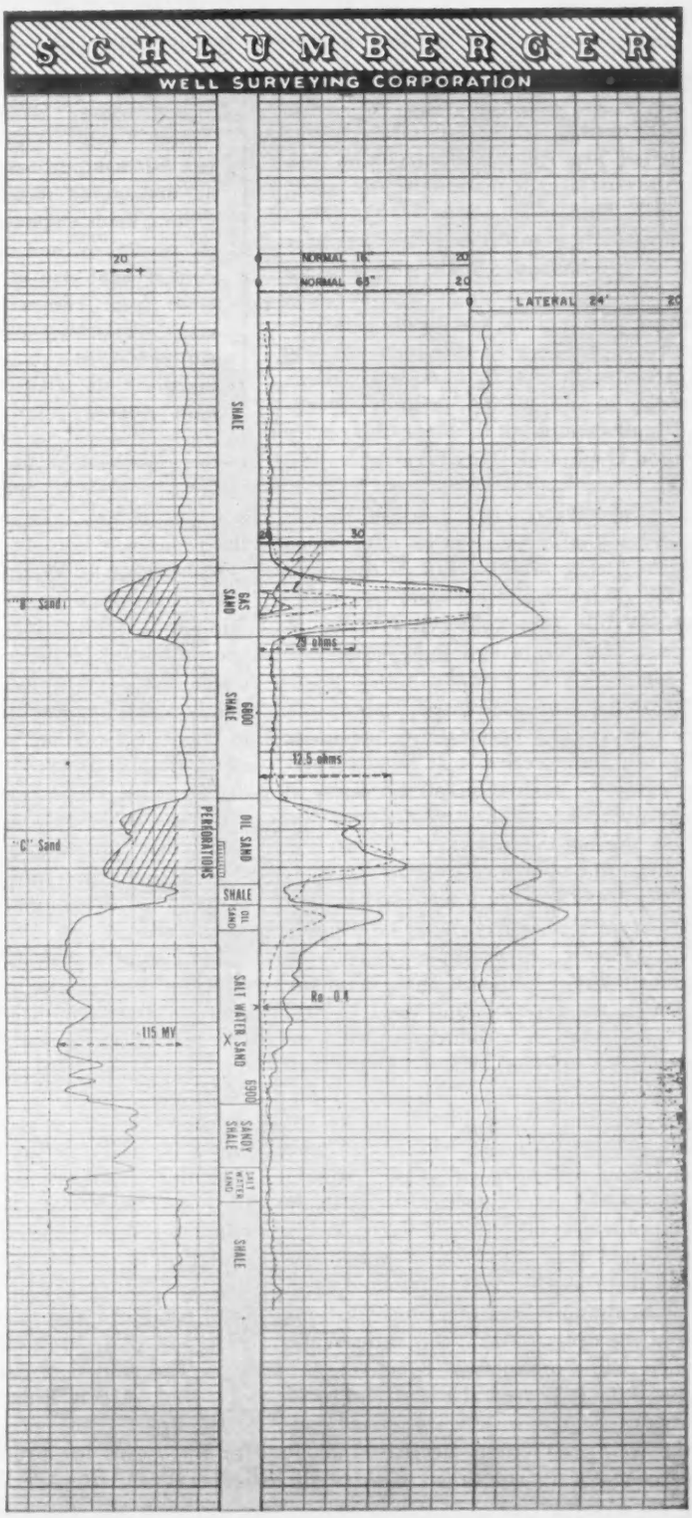
$p = \sqrt[m]{\frac{1}{F}} = 28\%$ for m = 1.8

CORE ANALYSIS

B Sand	Porosity	30%
	Permeability	800 md.
	Residual Water	43%
C Sand	Porosity	30%
	Permeability	800 md.
	Residual Water	42%

PRODUCTION RESULTS

Perforated: 6833-42 with 24 shots
Potential: 140 bbl. oil 28.3° API
Gas oil ratio 758/1



SCHLUMBERGER
WELL SURVEYING CORP.
HOUSTON, TEXAS

Use of Improved Drilling Fluids in Well Completion

By J. E. SHERBORNE and P. W. FISCHER
Union Oil Company of California

THE AUTHORS discuss the benefits to be anticipated through the use of drilling fluids engineered to meet local conditions, and demonstrate the gain through use of certain special muds over results obtained with usual water-base muds. The paper was presented before a recent meeting the AIME at Los Angeles, and is here printed substantially in full.

THE need of better fluids for drilling wells has long been recognized and during the past decade marked improvement of such fluids has occurred. However, until recently greatest emphasis has been placed on enhancing drilling operations. Most notable advances have been in the control of sloughing and heaving formations and in the penetration of salt and hard materials. As a consequence, much more rapid and efficient drilling of wells under all conditions in which the rotary method is employed has been made possible.

The fact that the drilling fluid might be of great importance in its effect upon the producing horizon and in the completion of wells has been slowly recognized. While some observers[1] noted as much as ten years ago that actual well productivities were many times lower than those predicted from laboratory measurements of permeability, adequate tools and data were not at hand to permit complete evaluation of the cause of this divergence. The tremendous increase during the past several years in technical knowledge relative to reservoir and well performance has enabled investigators[2-11] to analyze more thoroughly well behavior and completion and to establish beyond doubt that in many instances the type of fluid used to drill and complete the producing formation controls to an important extent well productivity.

Among the more important recent published information relative to well completion the work of Wade[12] should be mentioned. As a result of the analysis of data for several hundred wells, Wade determined that the ratio of actual capacity to produce to that predicted from theoretical and laboratory considerations was of the order of 0.25; this ratio Wade termed the "productive effectiveness." These data indicated also that for over 325 wells drilled with water base mud, initial well productivity decreased about 1 percent per day with increase in the amount of time the fluid was against the producing horizon.

As a result of discussion with Wade, the writers were supplied with data pertaining to individual fields in which special fluids had been used to an appreciable extent. The average of the productive effectiveness ratio for the wells in these fields drilled with oil-base fluids is 0.190 as compared to 0.110 for wells drilled with fresh water base mud in the same fields. It would appear on this basis that the wells drilled with the special muds are initially almost twice as good as the comparative fresh water base wells.

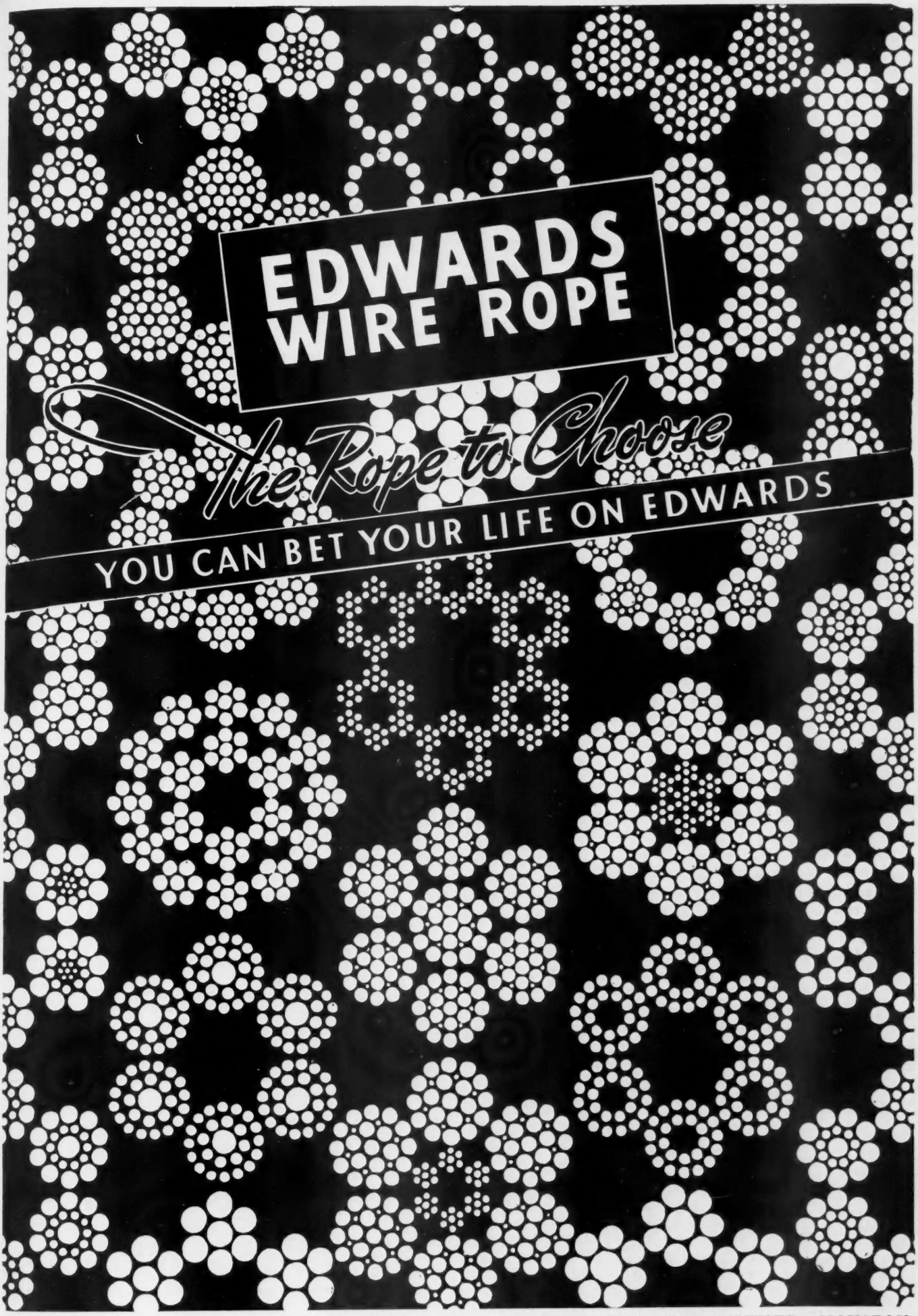
In Figure 1 is shown the adverse effect of fresh water on a high productivity well which, because of a leak in the surface equipment, had to be killed with fresh water for a period of only 24 hours. This information has been reproduced from a previously published paper by Johnston and Sherborne.[9]

With the realization of the importance of research, investigators have undertaken the development of drilling fluids designed to provide better well completion and a number of such fluids have been produced and satisfactorily used.

The Action of Drilling Fluid Upon Formations

In order to properly evaluate a fluid for its use in the producing horizon, it is necessary to understand as fully as possible how the drilling mud affects the formation. According to present concepts, three types of behavior appear to be important. They are first, water block; second, interaction between mud filtrate and certain of the component minerals of the reservoir rock; and third, plugging either by suspended or colloidal material from the mud and by solid material caused to be displaced within the formation or deposited from solution by chemical interaction resulting from invasion of filtrate material from the mud into the formation. The relative importance of these, of course, depends upon the nature of the formation and the drilling material employed, each becoming the more important for certain conditions.

WATER BLOCK. The effect upon the capacity of a porous rock to yield oil or gas produced by an increase in water saturation appears to be well understood as a result of the pioneer work of Wyckoff and Botset,[2] Muskat and Meres,[3] and Leverett and Lewis[4] and more recently numerous other investigators. Using the data of Leverett and Lewis applied to a formation capable of producing 100 barrels per day when its indigenous water content is 20 percent, a curve has been constructed showing the decrease in productivity resulting from increased water saturation. This relationship is presented in Figure 2. In constructing this graph, the formation was assumed to contain a water saturation of 20 percent before invasion and, of course, at this saturation the productivity is 100 percent, although this condition does not represent the condition of highest permeability to oil. The abscissa represents an increase in water saturation above the water saturation indigenous to the formation. It will be observed that an increase in water saturation of only 25 percent of the pore space results for this case in a reduction in productivity to only 41 percent of original capacity. Inasmuch as the


EDWARDS
WIRE ROPE
The Rope to Choose
YOU CAN BET YOUR LIFE ON EDWARDS
E. H. EDWARDS COMPANY — SEATTLE • PORTLAND • SAN FRANCISCO • LOS ANGELES • HOUSTON

relationship just presented is for uniform distribution of water completely throughout the formation it is, of course, not strictly applicable to evaluation of a producing well where invasion penetrates radially, presumably only a short distance into the formation. However, using data such as that presented in Figure 2 to establish the effect upon the invaded part of the zone, it is possible then to evaluate the diminution in well productivity resulting from the increased water saturation in the impregnated region adjacent to the well-bore. The magnitude of this effect can be seen in Figure 3. In this graph two curves are presented; one for a condition in which the water saturation has increased until the permeability to oil in the invaded region has been reduced to only 25 percent of its original value, and the second for a permeability of only 10 percent of the original. It is important to observe that, in each case, a lateral invasion of only a few inches results in a very marked decrease in productivity.

The increase in water saturation resulting from invasion disturbs the capillary equilibrium existing within the reservoir. As a consequence, there is a tendency for restoration of this balance during initial producing conditions which causes removal of some of the intruded water. The degree to and rate at which original conditions are restored are not yet fully known and undoubtedly vary for the different zonal conditions encountered. However, careful observation of well behavior in the period just subsequent to well completion reveals that for wells completed with fresh water drilling fluids many months are frequently required for maximum producing potential to be reached.

INTERACTION BETWEEN INVADING FLUID AND ROCK MATERIAL. The decrease in well productivity resulting from interaction between various components of the reservoir rock and the invading fluid appears to be much more permanently sustained than that resulting from water block and in some cases would appear to occur to such an extent as to render an otherwise profitably producible well noncommercial. Among the first to publish data indicating the possible magnitude of this effect were Johnston and Beeson,[13] who showed in a comprehensive survey that the majority of cores from oil producing formations which they examined were adversely affected by fresh water. Similar laboratory data for a variety of producing zones are presented in Figure 4. In this figure, the reduction in permeability to fresh water as compared to the permeability to formation brine is plotted as a function of time. It will be noted that while two of the cases shown indicate practically no effect resulting from fresh water, the majority show an important reduction. In some cases a tremendous reduction occurred in an exceedingly short time interval and in others complete disintegration of the core occurred before tests could be made. Strictly speaking, a type of investigation more nearly simulating reservoir conditions would have been to determine the permeability to flow of oil in the presence of interstitial brine before and after treatment of the core with fresh water. Such data are available only for a limited number of cases. However, for the cases studied, cores exhibiting a reduction in permeability to fresh water also exhibit a reduction in effective permeability to oil after contact with fresh water. This decrease in permeability is believed to result for the most part from swelling of clay and other hydratable materials present as part of the formation.

In addition to the performance of tests with fresh water, the aqueous material extruded from a lime-tannate mud was carefully filtered, biologically sterilized with ultra-violet light and similar permeability measurements were performed with it. The belief that such a filtrate would adversely affect productive capacity was substantiated, for a marked reduction in permeability to the aqueous phase occurred. The results of this test appear in Figure 5, which shows the percent reduction in permeability to the aqueous phase as a function of time. The original brine permeability is taken to be 100 percent.

A complete discussion of the behavior of clays and similar materials in the presence of aqueous solutions is beyond the scope of this paper. The reader is referred to the published works of Grim,[14] Hendricks[15] and others[16-19] for detailed consideration of these substances. However, the extent to which such materials swell is a function of the amount and nature of the ions present in the clay-water system. To illustrate this, the following demonstration has been prepared. First, samples of two clays typical of those encountered in California producing horizons were obtained. They are kaolinite, which is virtually non-swelling, and montmorillonite, which swells to a great extent. One gram samples of each of these materials were placed in graduated cylinders and 20 milliliters of distilled water were added to each. The resulting swelling is shown in Figure 6, which is a photograph of the demonstration referred to above. Samples of the dry clay are also shown for comparison.

A similar demonstration to indicate the effect of ionic concentration upon swelling has also been prepared. In this case, to a series of one-gram samples of dry montmorillonite were added 20 ml. portions of a polyvalent ion salt solution ranging in concentration from 0 to 3.0 percent by weight. This demonstration is presented in Figure 7. It can be seen that a markedly lower swelling relative to that induced by the fresh water occurs in salt solutions as the concentration of the salt is increased. Similar re-

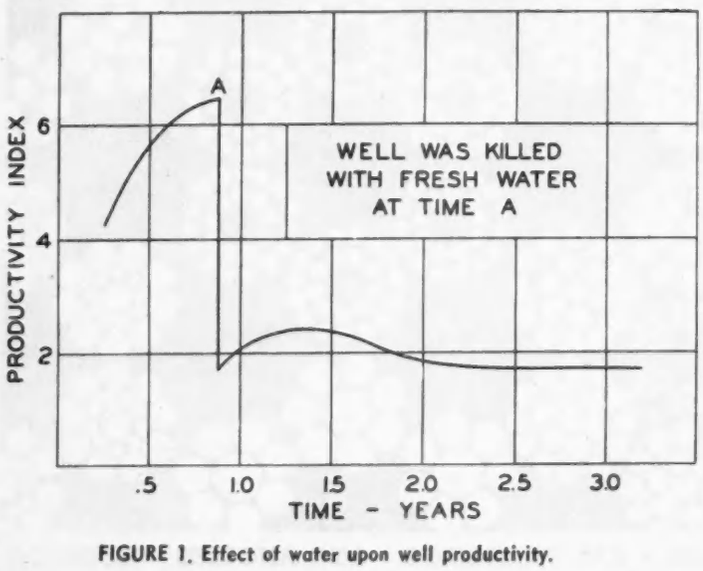


FIGURE 1. Effect of water upon well productivity.

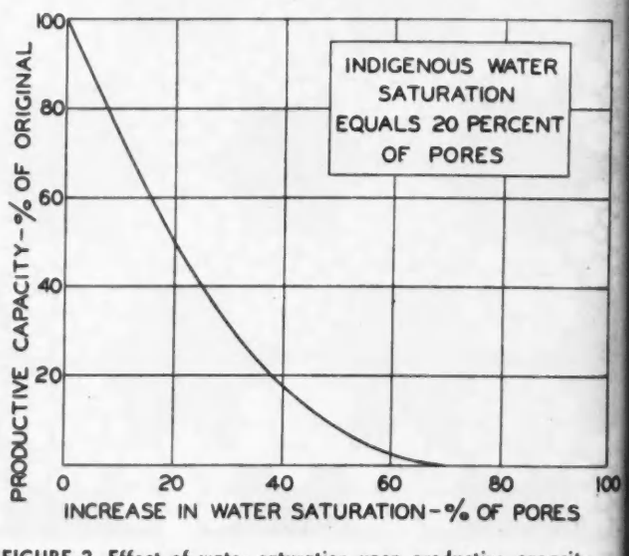
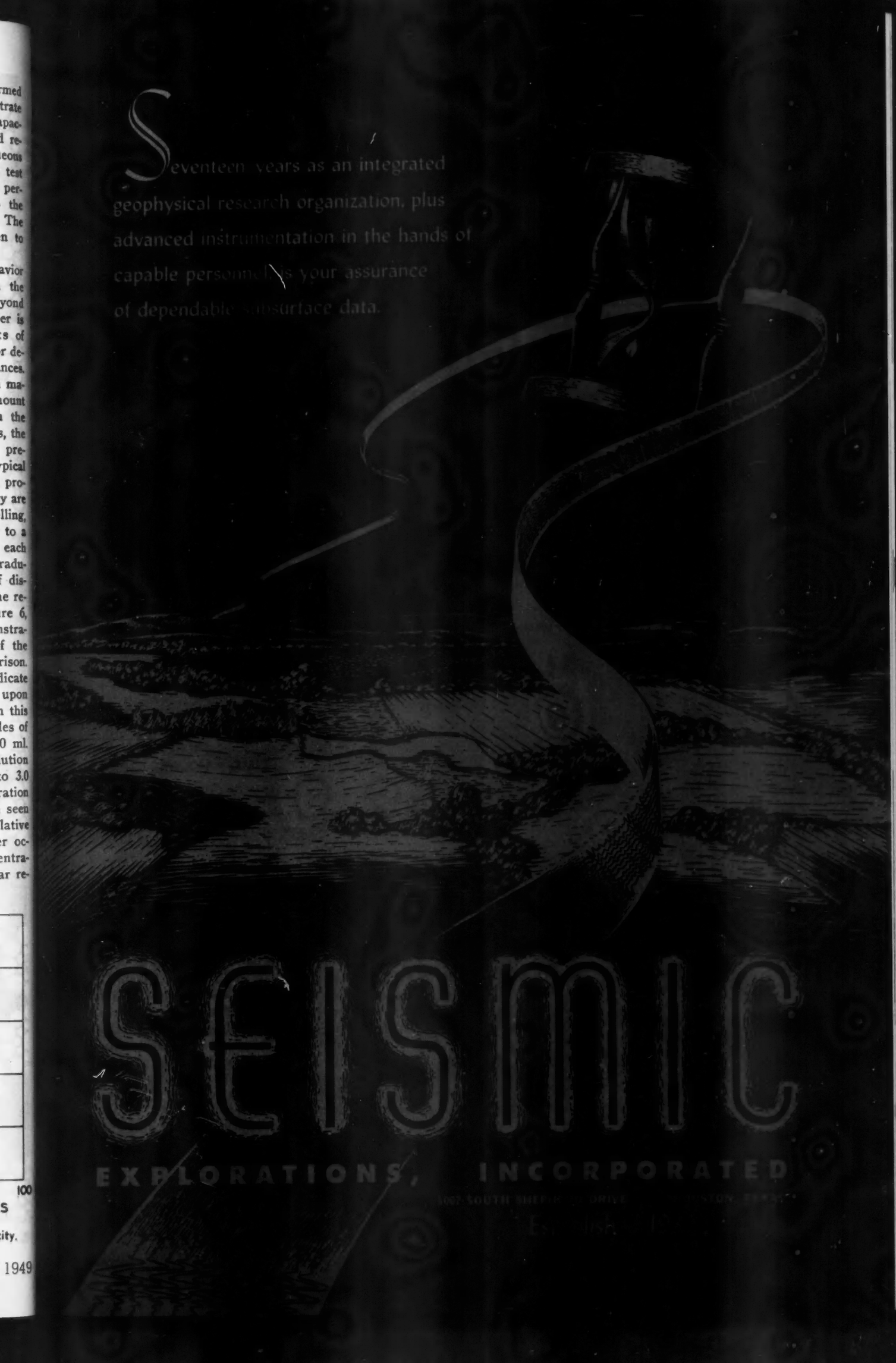


FIGURE 2. Effect of water saturation upon productive capacity.


Seventeen years as an integrated
geophysical research organization, plus
advanced instrumentation in the hands of
capable personnel is your assurance
of dependable subsurface data.
seismic
EXPLORATIONS, INCORPORATED

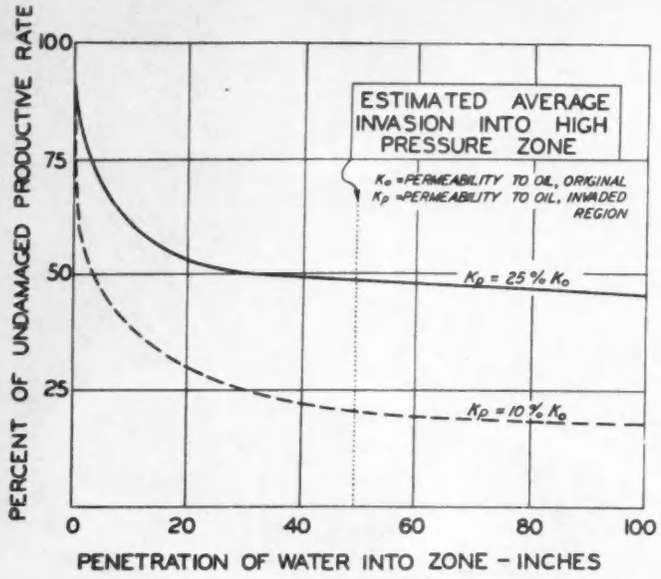


FIGURE 3 (Top left). Extent of damage to zone by fresh water invasion.

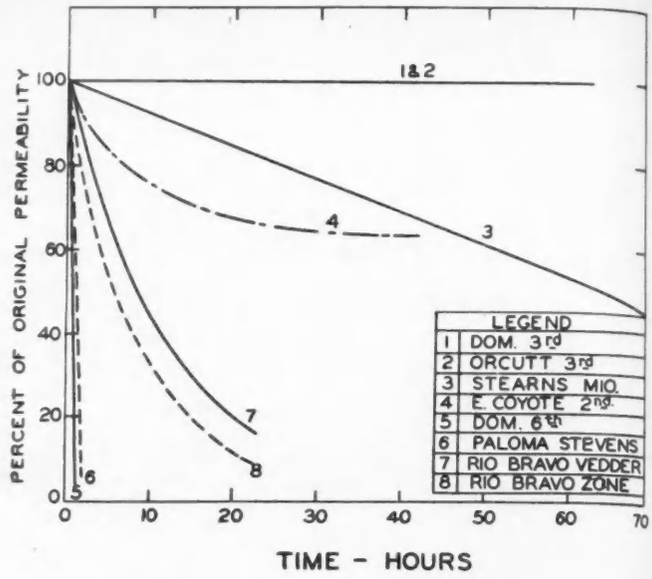


FIGURE 4 (Top right). Reduction in formation brine permeability by fresh water.

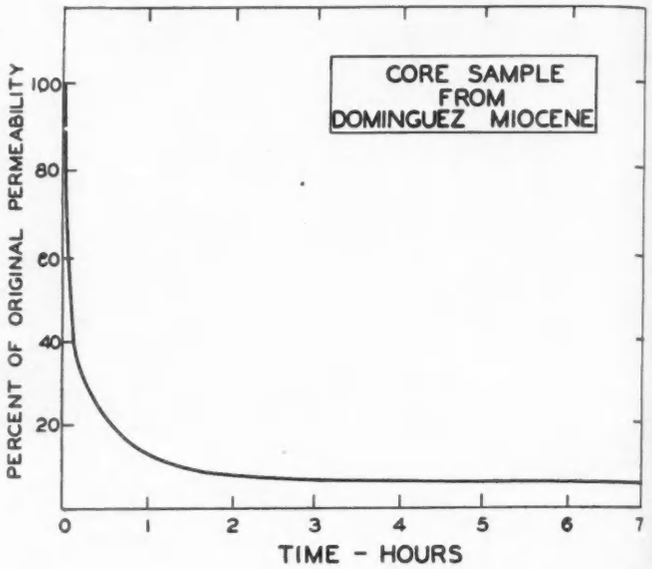


FIGURE 5 (Right). Reduction in formation brine permeability by lime-tannate mud.

sults can be obtained with other polyvalent salts although the quantitative values vary somewhat.

PLUGGING. Of the three items enumerated as important in the relationship between the drilling fluid and the formation, the mechanism and order of importance of plugging are least understood. Although considerable research is being conducted at present to evaluate this factor, more satisfactorily, little concerning it can be said at present.

Development of Improved Fluids

A considerable amount of work has been done to develop fluids more satisfactory for drilling producing zones. A number of such special fluids are commercially available and have been used. These include oil base, lime tannate, and sodium starch muds. All of these fluids are in certain respects superior to fresh water muds and all have disadvantages. In an effort to overcome some of these disadvantages, the fluids described below were developed. While it cannot be said that all disadvantages have been eliminated, it is believed that each of the fluids described in this paper are improvements over existing materials.

On the basis of considerations such as those above, several approaches to the development of improved fluids can be taken. Two very promising means of attack are, first, development of fluids from which no water can penetrate the formation; and second, development of fluids the filtrate from which would tend to alter the formation to the extent that it would, when reduced to a stabilized producing condition, be more productive perhaps than it was in its uncontaminated state. For the former, the further investigation of oil base and organic compounds seemed to offer greatest possibility for success, while for the latter, research upon salt-containing muds appeared the better approach. As a result of such research, fluids of both types have been developed and have been successfully used in a number of wells.

OIL-BASE FLUID. In developing an oil-base fluid, emphasis was placed on producing a material having the following characteristics:

1. Low in cost.
2. Composed predominantly of crude oil or low cost readily available refined petroleum products.
3. Containing no materials which might cause plugging of the formation.
4. Containing an agent capable of acting in unison with such naturally occurring asphaltic and naphthenic materials as may be in the crude or refined oil, clay and other similar substances to form a low fluid loss thixotropic composite.
5. Providing a satisfactory electric log.
6. Having desirable properties as a drilling fluid.
7. Having desirable properties for well completion.

A material satisfying most of the above requirements has been made employing a completely oil soluble metal ester and other ingredients, the nature of which cannot be revealed at this time. A number of such compounds can be prepared and have been studied. Such an ester

Better Than Ever!

GOODALL long-life *"FLEXO"* ROTARY HOSE

. . . with new Cord Carcass

Remember how cord tires revolutionized motoring back in the 1920's . . . how cord increased average tire life up to 80%?

Now, Goodall Rubber Company has originated the application of the cord principle to the fabrication of heavy-duty rotary hose — replacing the old-style fabric carcass with multiple plies of cord to increase hose life.

WHY CORD CONSTRUCTION IS BETTER

Longer life is assured with the new "FLEXO" cord construction because it eliminates the principal cause of rotary hose failure—the cutting action of threads in the fabric carcass against each other under torsional twist. The individual plies of cord are laid parallel to eliminate this cutting action and are protected from each other and from the cables in the pressure element by layers of rubber.

Greater strength results from the new construction because cord is much heavier and stronger than the fabric it replaces. Also, internal stresses are minimized by laying the cord carcass at exactly the same angle as the pressure element cables.

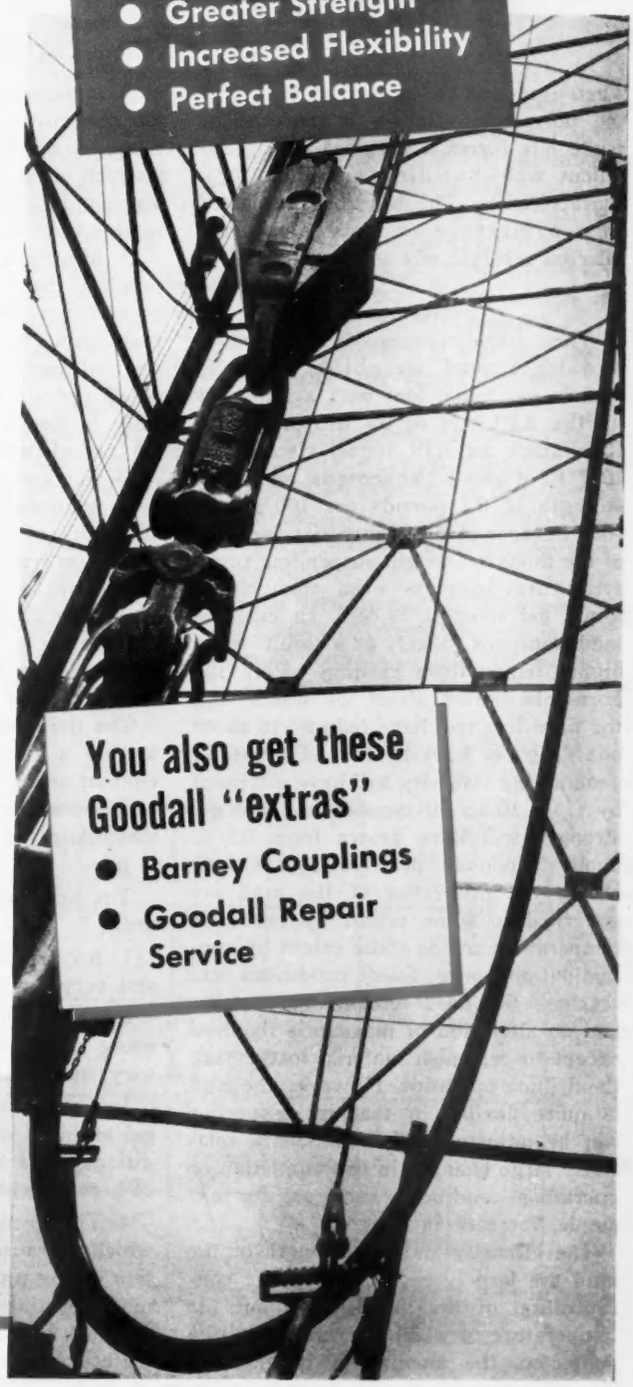
Increased flexibility—even superior to the famous Long-Life "FLEXO"—is produced by cord construction and contributes to longer life and easier handling.

Perfect balance, the result of uniform tension throughout the entire length of the hose, makes "FLEXO" handle naturally—without distortion—and resist the tendency to twist or elongate under pressure.

Extensive field tests under severe drilling conditions have proved that the new "FLEXO" Rotary Hose with cord construction withstands maximum pressures and heavy punishment far longer than any other hose.

ADVANTAGES

- Longer Life
- Greater Strength
- Increased Flexibility
- Perfect Balance



You also get these Goodall "extras"

- Barney Couplings
- Goodall Repair Service

GOODALL RUBBER COMPANY
TRENTON, N. J.

GOODALL RUBBER COMPANY OF TEXAS: Houston, Texas
GOODALL RUBBER COMPANY OF CALIFORNIA: San Francisco, Los Angeles, Seattle, Salt Lake City
GOODALL RUBBER COMPANY: St. Paul, Minn.
EXPORT: Goodall Rubber Company, Trenton, N. J.
DISTRIBUTORS: Texas and Louisiana — Houston Oil Field Material Co. — Wilson Supply Co., Oklahoma — Iverson Supply Company

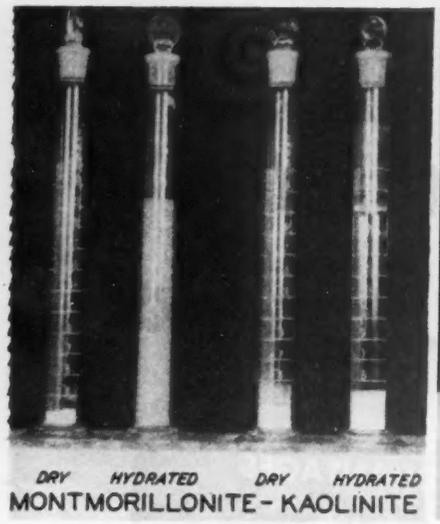


FIGURE 6. Fresh water hydration of clays.

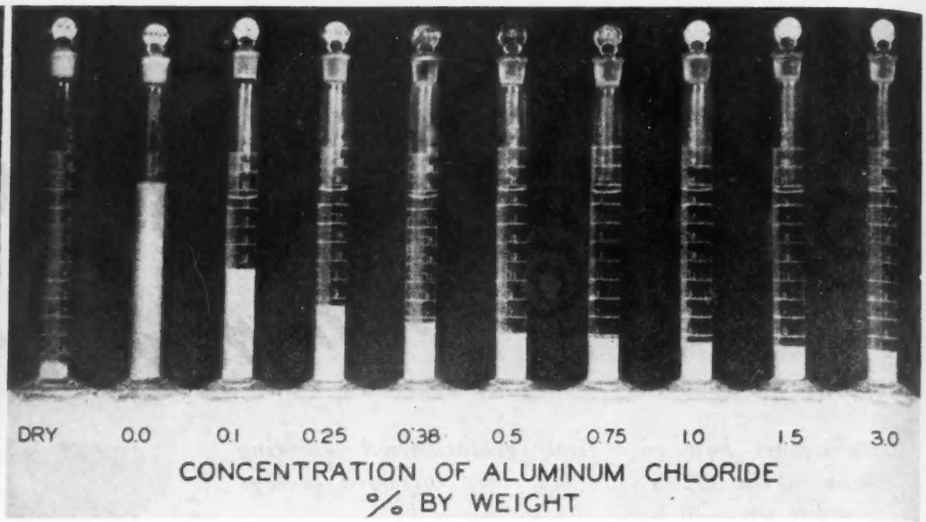


FIGURE 7. Montmorillonite in aluminum chloride solutions.

when used with the proper additives and the polymeric solubles in residual or crude oils forms a material having excellent wall-building and thixotropic characteristics. The base oil is selected from a mixture of crudes or from selected residual oils.

Performance

When freshly prepared, the mixture provides a mud weighing about 60 pounds per cubic foot with a fluid loss by the API test of 0.1 ml. or less in 15 minutes, an API funnel viscosity at 100° F. of about 150 seconds, and a gel strength of 0.5 pounds per 100 square feet. Because of the high surface activity of the fluid, the weight suspending properties are adequate even though the initial gel strength is low. In use, the mud improves, largely as a result of the higher temperature existing within the bore-hole. After about 24 hours use, the filter loss will have reduced to about one drop per hour by the API test. In general, the viscosity will have increased by from 10 to 50 seconds and the gel strength will have grown from 0.5 to about 3 pounds per 100 square feet. While the properties of the mud are governed to some extent by bore-hole temperature and to some extent by contamination, once fixed conditions are reached, the mud remains very stable and no alteration or makeup is required except to replenish material lost during the drilling operation. However, the mud is quite flexible in that its properties can be adjusted to accommodate relatively large changes in contamination or operating conditions such as, for example, increase in weight.

The viscosity and gel strength of the mud are largely controlled by the concentration of the metal ester, but the temperature to which the mud has been subjected, the amount of weight material or crude oil and to some extent the composition of the crude also affect them. A curve is presented in Figure 8 which shows the effect upon the mud viscosity by addition of barytes as weight material.

It has been shown by actual field practice that gel strengths of 1 to 2 pounds per 100 square feet are more than ample to support weight materials and cuttings in this mud. Mud weights of 85 pounds have been used successfully in newly mixed muds with only 0.5 pound per 100 square feet, while mud weights of 95 to 100 pounds have been maintained for two weeks with gel strengths of 2 pounds per 100 square feet. However, it is believed undesirable to attempt drilling for long periods of time with a mud having a gel strength of only 0.5 pounds per 100 square feet. It has been found that gel strength increases with viscosity.

The fluid loss of the oil-base mud is largely a function of the metal ester content and is always so low that methods of control of fluid loss are unnecessary. Any fluid which can be removed is oil.

The principal advantages of this fluid are:

1. No loss of water to the formation and very low filter loss.

2. The convenience and low cost of using crude oil usually available at or very near the drilling location.

3. The ability to control viscosity and gel strength over a wide range of conditions, thus allowing for maintenance of high weight muds.

4. The formation of an excellent cake which, because of the high concentration of the wall building material in the mud, remains intact during drilling operations, but which, because of the complete solubility of the metal ester in oil, fully disintegrates when the mud is replaced by crude oil—a factor of utmost importance in well completion.

5. Improved well productivity with elimination of long clean up periods subsequent to completion.

6. Savings in crew and equipment time resulting from faster drilling, use of less bits per foot and minimization of bailing and swabbing time during completion.

7. The ability to withstand cement contamination without deterioration nor the need for treatment for cement cutting.

The principal disadvantages are:

1. The mud is still more costly than fresh water mud.

2. It is more disagreeable to handle than fresh water mud, although as the crews have become familiar with its use, it has become more acceptable.

3. As might be expected, conventional electric logs obtained in this fluid are generally not as satisfactory as those taken in water-base fluids.

4. Like other oil-base fluids, weight material will slowly separate from it and collect at the bottom of the tank when the fluid is stored, although this is minimized because of the mud's superior thixotropic properties. However, the mud can easily be maintained by the provision of adequate facilities for agitation.

5. Excessive contamination by water will damage this mud. However, amounts of water contamination up to about 10 percent by weight can be handled without serious difficulty. With normal care in drilling, contamination by large quantities of water should not occur.

POLYVALENT ION-STARCH MUD. Rather than to produce a material from which no water could enter

the formation, as in the case of the fluid discussed above, in this instance a controlled amount of loss to the formation of water containing the desired concentration of a polyvalent ion was sought. Because of the great flocculating power of polyvalent ions even at small concentrations, it is necessary to use a dispersing agent such as starch to obtain a satisfactory clay base mud containing such ions. However, with moderate amounts of starch, a mud having excellent drilling properties can be prepared.

It should be stressed that the quality most sought after in this type of fluid is an alteration of the hydratable materials in the invaded zone by base exchange and flocculation to the end that the stabilized permeability to oil of the producing zone will be greater than was the case for its original condition. How successfully this can be accomplished in practice remains to be seen, although for the 20 odd wells drilled with this material to date, marked improvement over water base completions has been noted on comparable wells. It is believed that the formations containing indigenous water low in salt concentrations are most susceptible to improvement by the polyvalent ion mud, although it would appear that a zone productivity superior to that provided by fresh water mud can nearly always be expected when the polyvalent ion mud is used.

With the normal amount of clay used, a mud weighing about 70-72 pounds per cubic foot can be prepared having an API filter loss of 1 to 3 ml. per hour, depending upon the amount of starch used. Such a mud would have an API viscosity of about 40 seconds and a gel strength of 3 to 4 pounds per 100 square feet.

The polyvalent ion mud can stand a large amount of water dilution without great change in filter performance and can be weighted heavily without serious alteration of properties. It is also resistant to temperature change and has been successfully used in hot, deep wells with less trouble than that encountered with fresh water muds in similar deep wells.

Performance curves for such a mud prepared with Santa Maria Valley clay are shown in Figures 9 and 10. This clay was used because it makes a fresh water mud having very poor properties. It can be seen from the curves that even with a poor clay, an excellent mud can be prepared. In practice it is desirable to use a good clay and thus reduce the amount of more expensive ingredients required.

Behavior typical of the polyvalent ion starch muds with respect to filter performance and viscosity as a function of starch content are shown in Figure 9. It is of interest to note that, in practice, the filter performance is generally lower by one or more ml. per hour than that of the freshly prepared mud.

Behavior of filter performance and viscosity typical of the mud with respect to amount of weighting material are shown in Figure 10. When clay is used as a weighting agent in the polyvalent ion mud, the filter performance is improved; however, marked increase in viscosity occurs, as is indicated in Figure 10. In actual practice when high weight muds are required it is desirable to use a moderate amount of clay and a heavy inert material such as barytes. It should also be noted that with the clays used in the field for preparing the mud, the increase in viscosity with clay content is much less than that indicated for a mud prepared from Santa Maria Valley clay.

While the polyvalent ion muds most likely to be used in the field can stand considerable cement contamination without deleterious effect, if too much occurs, it is necessary to treat the mud. This can be done by the usual sodium bicarbonate treatment used in fresh water mud.

Since starch is subject to bacteriological and probably enzyme consumption, it is necessary to use a preservative in the mud and to add small amounts of starch and preservative daily as the mud is used. In spite of the susceptibility of the starch to fermentation, this mud has been stored without difficulty for several weeks when the proper precautions were taken of increasing the preservative content to greater than normal concentration before storing.

It should also be noted that sometimes the clays encountered in drilling are assimilated into the mud just as is the case with fresh water mud. Under these circumstances, it is necessary to dilute the mud with water and add the necessary component materials to restore the original balance. Under these conditions additional mud accumulates, which, if it must be discarded, represents a loss. This can be minimized if a drilling program involving the use of the mud in several wells is in operation.

Such a mud has been successfully used in over twenty wells to date. Its advantages may be summarized as follows:

1. The mud, when used under the proper circumstances, tends to improve well productivity.

2. When used instead of fresh water, it minimizes or completely eliminates swelling of hydratable material within the formation.

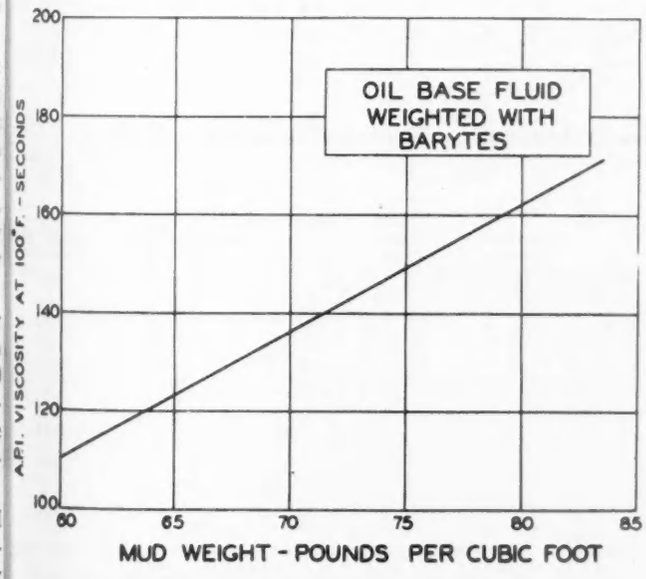


FIGURE 8. Effect of weight on oil-base fluid.

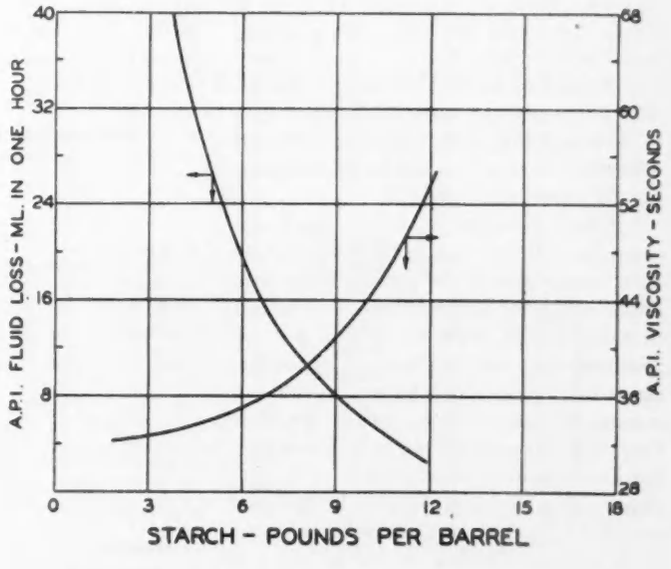


FIGURE 9. Effect of starch on polyvalent ion mud performance.

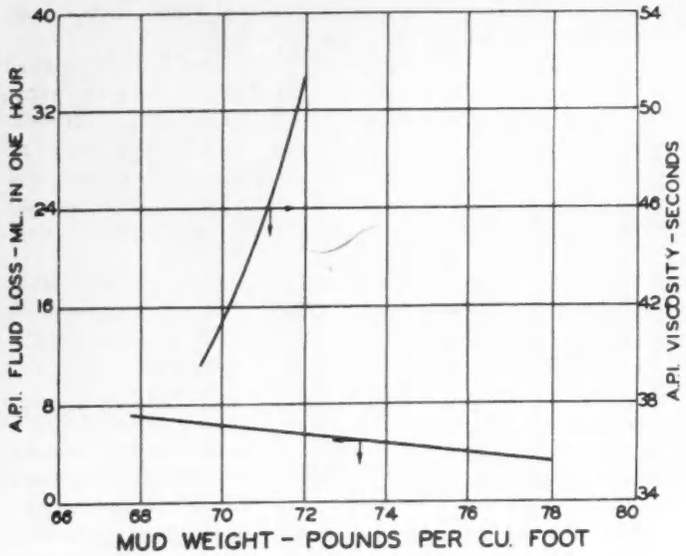


FIGURE 10. Effect of weight on polyvalent ion mud performance.

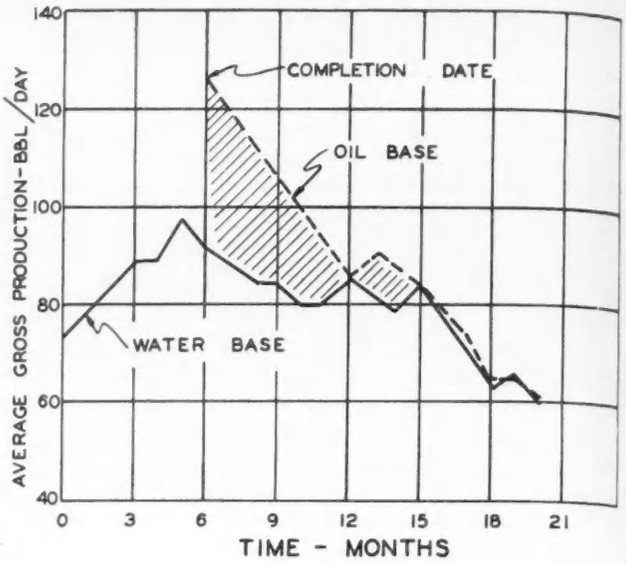


FIGURE 11. Comparison of initial well productivity in zone with little hydratable material.

3. It is less costly than oil-base fluids.

4. It may be used to dig deep, high temperature wells without the difficulties experienced with fresh water clay-base muds.

5. A mixture having satisfactory drilling properties weighing as little as 65 pounds per cubic foot and having a filter loss of only 3 to 4 ml. per hour can be made if desired.

6. It is unharmed by salts commonly encountered in drilling operations.

7. It can tolerate considerable cement contamination without harm and excessive contamination can usually be remedied.

Disadvantages

The principal disadvantages of such a mud are:

1. It costs more than the average fresh water mud.

2. Although a satisfactory electric log can be obtained in this mud in some localities, there are a number of fields in which reversals of the self potential curve occurs. Also for some zones there is a shifting of the lateral curve although it is believed that individuals who have to interpret the resistivity logs will find departure curves[19] an aid in understanding the observed behavior.

3. There is some evidence which appears to indicate that, with this mud as with other starch or starch substitute fluids and other drilling fluids which tend to form a thin, film mud cake, a more competent cement job occurs. This appears to require more bullets to make a satisfactory completion when it is necessary to gun perforate. It is by no means certain, however, that the mud is the major cause of this difficulty. It has been established[20] that a recently adopted method of cementing involving the use of scratchers and moving of the casing string while cementing creates a cement job more difficult to perforate with a few holes per foot than was the case before this technique became usual practice.

ECONOMICS OF SPECIAL DRILLING FLUIDS. In wells such as those drilled in California, the additional cost for special drilling fluids averages three to four thousand dollars per well. It is important to evaluate what will be obtained for this expenditure. In general, three or four benefits can be expected. They are first, an increased initial productivity; second, decreased drilling cost and less wear on bits; third, decreased crew and equipment time in bailing and swabbing prior to completion; and fourth for formations in which hydratable materials are caused to swell when fresh water is used, an increase in ultimate recovery.

While the increase in initial productive effectiveness resulting from the use of special fluids has been referred to earlier in this paper, it was thought worthwhile to present a resumé of such quantitative data as are available at this time. For this purpose, Table 1 has been prepared which shows the ratio of a productive index of wells drilled with special fluid to the index for wells drilled to the same zone with fresh water. Where the data have been obtained from the literature, the source has been given. It should be noted that inasmuch as the data were obtained from several sources, the indices for the several fields and zones are not necessarily the same and may be productivity indices, specific productivity indices or production effectiveness as defined by Wade[12]. Needless to say, however, each ratio shown has for its enumerator and denominator the same type of index. It was not possible with the data available to convert all of it to the production effectiveness ratio, although this would have been desirable.

It is only fair to observe that because both representative permeability and productivity data are necessary in order to make an evaluation of productive effectiveness, comparsions for only a few wells can be made, and consequently the

TABLE 1
Comparison of Type of Fluid Used During Completion on Well Productivity

FIELD—ZONE	Reference Number	INDEX			Ratio* of Indices
		Fresh Water Mud	Polyvalent Ion Mud	Oil-Base Mud	
Coalinga, Lt. Oil	22	3.1	....	4.3	1.3
Coalinga, Tar	22	1.1	....	1.8	1.6
Ten Sections	23	1.19	....	2.14	1.80
Ten Sections (after 200,000 bbls.)	23	0.92	....	1.21	1.32
Cole's Levee	23	0.72	....	1.16	1.61
Cole's Levee (after 150,000 bbls.)	23	0.10	....	0.50	5.00
Paloma	23	0.90	....	2.22	2.47
Elk Hills	23	0.57	....	2.34	4.10
Wilmington	24	0.127	....	0.143	1.13
Brea-Olinda	26	1.00	2.42	....	2.42
Brea-Olinda	26	1.00	....	2.24	2.24
Dominguez 7th & 8th	24	1.00	....	2.49	2.49
Dominguez 6th	24	0.07	0.093	....	1.33
Ventura Avenue	24	0.153	....	0.177	1.16
Naranjal	26	0.10	0.19	....	1.90

* Ratio = Average of indices for special fluid / Average of indices for fresh water fluid

Strength Means Extra Life for REPUBLIC *Electric Weld* CASING

● Recent salvage operations have shown that some oil country steel tubular goods, put in service as far back as twenty years ago, still are 90% usable! Much of the pipe recovered in such salvage searches has been Republic Electric Weld Casing . . . demonstrating anew how its uniformly high strength means extra life and an extra margin of hole protection.

Largely responsible for this uniformly high strength is the advanced Electric Weld process by which Republic Casing and Tubing are manufactured. Cold forming, full normalizing and cold sizing all are integral steps. They help produce a tubular steel wall of high ductility, with uniform grain structure and high yield point . . . with the weld fully as strong as the rest of the wall.

Its high yield strength combines with uniform roundness to give Republic Electric Weld Casing extra resistance to collapse. Since the wall is uniformly round and thick, plenty of tough steel is left under thread roots *all around the pipe*—additional protection against disastrous and expensive pull-outs.

It will pay you well—in long-time protection and time saved in make-up—to insist that Republic Electric Weld Casing and Tubing be delivered to your rigs.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

REPUBLIC *Electric Weld*
NORMALIZED CASING AND TUBING

REPUBLIC STEEL
REG. U.S. PAT. OFF.

Other Republic Products include Line Pipe—Carbon, Alloy and Stainless Steels—Upson Studs, Bolts and Nuts—Electrunite Heat Exchanger Tubes

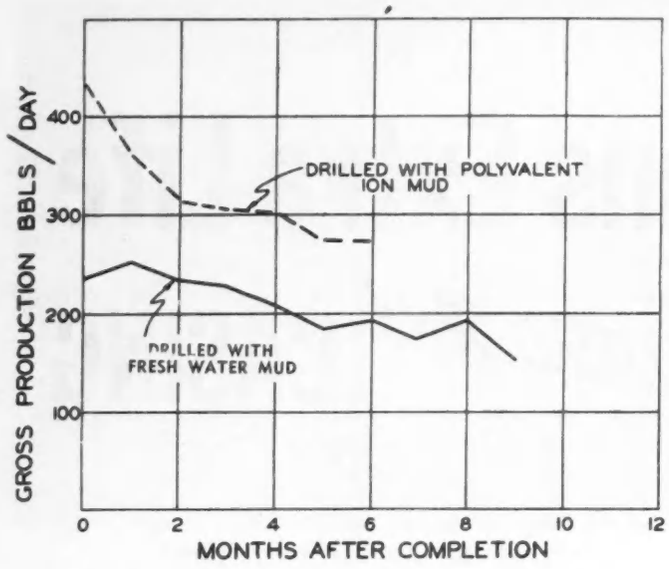


FIGURE 12. Comparison of initial well productivity in zone with hydratable material.

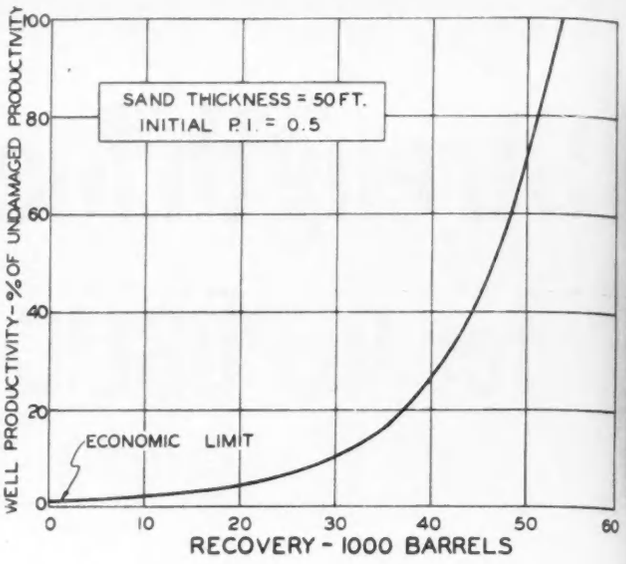


FIGURE 13. Effect of decreased producivity on recovery.

data composing the table cannot be said to constitute a statistical array. However, it is not believed that it can be by accident that all of the ratios are greater than one.

It is of interest to note in Figure 4 once more that the data for two of the zones studied exhibited no impairment of permeability by fresh water hydration. A number of wells penetrating one of these zones have been completed with oil-base fluid. For these wells no clean-up period immediately subsequent to drilling occurs, whereas corresponding wells completed with fresh water mud in the same zone require several months to reach maximum productivity. As might be expected for such a zone, the wells drilled with water do in time approach the oil-base completions in productive capacity, presumably by removal of infiltered water.

Comparison of the two types of completion in this zone indicates that for the wells completed with special fluids, the increased production during the time the well would normally be cleaning up is on the average sufficient to justify the use of the special fluid. To illustrate this, production data for similar wells, one drilled with fresh water mud, the other with oil-base, are presented in Figure 11.

For zones where appreciable hydration is believed to occur, it would be expected that the productivity of the well completed with the special fluid would continue to remain above that of the well drilled with the fresh water mud, assuming that other conditions remained the same. The difficulty in obtaining examples where well conditions are sufficiently similar and where enough basic data are available to permit an evaluation will be apparent to all familiar with this subject. However, such an example is presented in Figure 12. In this graph production data for two comparable wells are shown. One was drilled with fresh water mud and the second with the polyvalent ion mud. These wells were completed near each other in the same zone, a zone for which data such as those presented in Figure 4 indicated a decrease in permeability with time similar to that presented by Figure 3. The two wells had initial gross specific productivity indices of 0.00343 and 0.00632 barrels per day per pound per square inch per foot for the fresh water and polyvalent ion muds respectively. The corresponding net specific productivity indices were respectively, 0.00101 and 0.00269. It should be observed that although the well drilled with the polyvalent ion-starch mud penetrated the zone to greater thickness than did the other well, the reservoir pressure in the vicinity of the well drilled with the special fluid was sufficiently lower than that in the location of the well drilled with fresh water to compensate for the greater penetration. The ratio of the product of sand thickness and static pressure for the well drilled with special fluid to the corresponding product for the other well is 0.97. It will be apparent from this discussion that a direct comparison of the productivities of these two wells in gross barrels per day as given in Figure 12 is justified. Examination of the graph reveals that the well drilled with the special fluid is approximately one and one-half times as productive as the well drilled with fresh water and that this advantage persists with time. The resulting economic advantages should be obvious. Additional data, although not so completely correlative as those presented, indicate similar experience with other wells in which the special fluids were used. To the writers' knowledge, only one field exists where the special fluids have been used for which no noticeable improvement in well productivity could be detected, although the polyvalent ion mud has not been tried in this field as yet. In the case of this field, insufficient data were available to permit evaluations such as those presented herein.

In general, the use of special drilling fluids permits faster drilling time and less wear on bits. Spectacular examples of this are cases where it has been found profitable to resort to the diamond drill and oil-base fluid. Under these conditions it is usually possible to core with high recovery for a much lower cost than for drilling in the same zone with fresh water mud. Frequently, under these circumstances, it is possible to obtain satisfactory producing wells where only mediocre to non-commercial wells were obtained with fresh water muds.

With both the oil-base and polyvalent ion muds, it has been possible to eliminate a large part of the time normally required for bailing and swabbing prior to completing a well drilled with fresh water. Comparsion of a large number of wells drilled by Union Oil Company has indicated a reduction in crew and equipment time of an average of four to five days per well, which in itself is usually sufficient to compensate for the added cost of the special fluid.

Ultimate Recovery

That ultimate recovery is in many cases increased when special fluids are used is more difficult to demonstrate in the early life of wells so completed, although Travers[11] showed such data for wells in the Wilmington field, California. Further, inasmuch as wells become non-commercial not when the reservoir is devoid of oil but when the expulsive forces can no longer overcome the resist-

Low Cost Model W Skid Winch

- A light weight unit that will do big jobs economically.
- It's ideal for water well drilling draw-works.
- Has new convenient foot operated controls.
- Can be mounted on small truck.
- Low operating cost.

u won't believe what this small unit ll do, but here's what operators say—

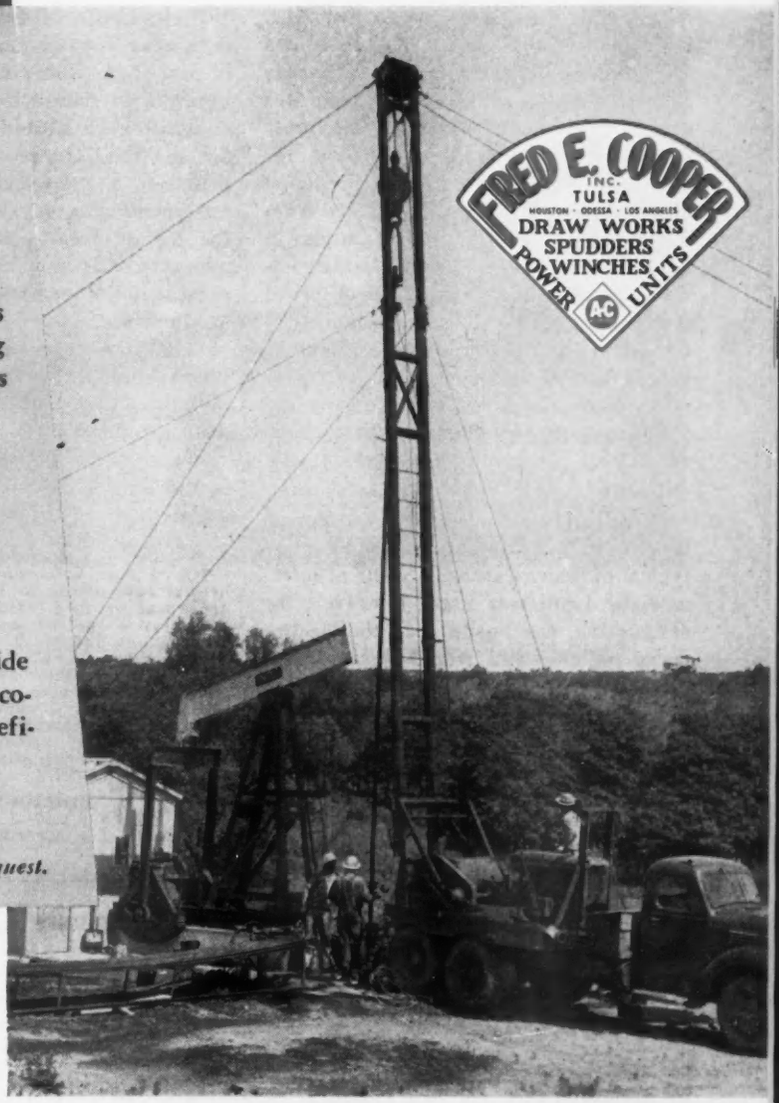
Strings of 2½" upset tubing 3180' long held asily with one hand on brake lever"

★"Example of the pulling speed of this unit is a recent job where 3600' of 2½" upset tubing was pulled in singles and laid down in two hours and 25 minutes".

"Time after time, I have checked fuel consumption for round trips of rods and tubing in singles laid down for depths of 3100'-3200', and find that four gallons or less is consumed during such jobs".

★"Considering the moderate initial cost, wide capacity range, ease of transportation and economical operating overhead, this unit is definitely my first choice for contract work".

★ *Names and addresses available on request.*



Top—Single Drum Model W Skid Winch, seat controls and foot operated clutches.
Above—Single Drum Model W. Skid equipped with twin pole mast.
Bottom—Double Drum Model W Skid Winch, ground operated foot controls.

FRED E. Cooper, Inc.

Phone 5-7191
P. O. Box 1890

TULSA, OKLA.

HOUSTON ODESSA LOS ANGELES

crease in ultimate recovery to an economic limit. Such a calculation has been performed, the results of which are shown in Figure 13. Here the decrease in ultimate recovery with percent reduction in original productivity resulting from impairment by invasion is shown. For purposes of illustration, referring once more to Figure 3, it can be seen that for an invasion of 50 inches where the permeability of the invaded region has been reduced to 25 percent of the undamaged permeability, the well's capacity to produce has been limited to 48 percent of what it would have been if no damage had occurred. It has been reported by R. H. Zinszer[25] that an analysis of electric log resistivity curves, taken in high pressure intervals drilled with high quality fresh water mud, indicates an invasion of approximately 50 inches occurs. Additional evidence indicates even greater penetration when zone pressures are low. For this condition, referring now to Figure 13, the predicted ultimate recovery has been reduced from 53,500 barrels to 45,800 barrels, a loss in ultimate recovery of 7600 barrels or about 14 percent. It should be observed that conservative values were chosen for this illustration in that only 500 pounds per square inch gauge initial reservoir pressure was assumed in a partially depleted zone 50 feet thick yielding a well which would have an undamaged productivity index of about 0.5.

In calculating the above hypothetical loss in ultimate recovery, a decline curve typical of many California wells of intermediate depth was used. However, the assumption was made that the decline curve for the well would be the same in each case; that is, with and without damage. Admittedly the rigor of this assumption may be subject to challenge. However, if one wishes instead to take a point of view most opposed to this and make the assumption that in each case the same ultimate recovery will be obtained but at necessarily reduced rates in the case of the damaged well, it will be found that the profit to be enjoyed from the undamaged well, when calculated at a reasonable discount factor and when the lower cost of operating the undamaged well is considered, will exceed that for the damaged well by a material percentage.

Summary and Conclusions

Evidence has been presented which indicates that well competion is an important phase of drilling operations and that the behavior of the drilling fluid used in penetrating the producing interval can profoundly affect the productive capacity of the zone.

Performance of two fluids for which data have not previously been published is described. These fluids are markedly different in their nature and in the use to which each should be put. One is an oil-base fluid from which no water can penetrate the producing horizon, while the second is a polyvalent ion starch mud, the filtrate from which is designed to interact with the hydratable material present in the formation so as to increase productivity.

While the above muds and the other special fluids discussed herein are initially more costly to use than fresh water muds, evidence is presented indicating that savings in drilling and completion costs and increases in recovery make their use profitable.

ACKNOWLEDGMENT

The writers acknowledge the efforts and helpful suggestions of B. P. Kantzer, P. H. Jones and Dr. R. S. Crog, and are particularly appreciative of the assistance afforded by F. R. Wade and W. F. Cerini. The effort of Scott E. Temple, M. G. Arthur, J. T. Ledbetter and the others associated with drilling operations who persevered with the writers during the early development of these fluids is gratefully recognized. Appreciation is also expressed to the management of Union Oil Company of California for permission to publish this paper.

BIBLIOGRAPHY

[1] H. C. Pyle and J. E. Sherborne, Core Analysis, Trans. A.I.M.E., Vol. 132, pp. 33-61, (1939).

[2] R. D. Wyckoff and H. G. Botset, Flow of Gas-Liquid Mixtures Through Unconsolidated Sands, Physics, Vol. 7, No. 9, pp. 325 (Sept., 1936).

[3] M. Muskat and M. W. Meres, Flow of Heterogeneous Fluids Through Porous Media, Physics, Vol. 7, No. 9, pp. 346 (Sept., 1936).

[4] M. C. Leverett and W. B. Lewis, Steady Flow of Gas-Oil-Water Mixtures Through Unconsolidated Sands, Trans. A.I.M.E., Vol. 142, pp. 107-116 (1941).

[5] M. C. Leverett, Capillary Behavior in Porous Solids, Trans. A.I.M.E., Vol. 142, pp. 152-169 (1941).

[6] S. E. Buckley and M. C. Leverett, Mechanism of Fluid Displacement in Sands, Trans. A.I.M.E., Vol. 146, pp. 107-116 (1942).

[7] H. H. Evinger and M. Muskat, Calculation of Theoretical Productivity Factor, Trans. A.I.M.E., Vol. 146, pp. 126-139 (1942).

[8] H. H. Evinger and M. Muskat, Calculation of Productivity Factors for Oil-Gas-Water Systems in the Steady State, Trans A.I.M.E., Vol. 146, pp. 194-203 (1942).

[9] Norris Johnston and John E. Sherborne, Permeability as Related to Productivity Index, API Drilling and Production Practice, Bull. 66 (1944).

[10] E. C. Babson, Prediction of Reservoir Behavior from Laboratory Data, Trans. A.I.M.E., Vol. 155, pp. 126-132 (1944).

[11] W. J. Travers, Jr., Completion Practice Related to Well Productivity, Pet. Tech. (Mar., 1942).

[12] F. R. Wade, The Evaluation of Completion Practice from Productivity Index and Permeability Data, presented before Los Angeles Meeting API (May, 1947).

[13] N. Johnston and C. M. Beeson, Water Permeability of Reservoir Sands, Trans. A.I.M.E., Vol. 160, pp. 43-55 (1945).

[14] R. E. Grim, Modern Concepts of Clay Materials, Jour. Geology, Vol. 50, pp. 125-275 (1942).

[15] S. B. Hendricks, Lattice Structure of Clay Minerals and Some Properties of Clays, Jour. Geology, Vol. 50, pp. 276-290 (1942).

[16] J. E. Giesking, Mechanism of Cation Exchange in the Montmorillonite-Beidellite-Nontronite Type of Clay Materials, Soil Science, 47, pp. 1-14 (1939).

[17] C. S. Ross and S. B. Hendricks, Minerals of the Montmorillonite Group U.S.G.S., Prof. Paper 205-B (1945).

[18] J. C. Griffiths, Clay Research in Oil Development Problems, Jour. Int. Pet. Tech., Vol. 32, No. 265, pp. 18-31 (1946).

[19] R. V. Hughes, Importance of Clay Studies in Water Flood Operations, Producers Monthly, Vol. 11, No. 4 and 5 (1947).

[20] H. G. Doll, J. C. Legrand and E. F. Stratton, True Resistivity Determination from Electric Log, presented before Los Angeles Meeting A.P.I. (May, 1947).

[21] A. J. Tepletz, Casing Cementing and Perforating Practices, Oil and Gas Journal, Vol. 47, No. 19, pp. 69 (Sept., 1948).

[22] W. H. Farrand and W. A. Clark, Drilling Fluid for the Completion of Shallow Wells, presented before Los Angeles Meeting A.P.I. (March, 1944). Also: Oil Weekly, Vol. 113, No. 9, May 1, 1944.

[23] Glenn V. Kersten, Results and Use of Oil Base Fluids in Drilling and Completing Wells, Drilling and Production Practice, A.P.I., pp. 61-68 (1946).

[24] F. R. Wade, Private communication.

[25] R. H. Zinszer, Use of Electrode Spacing in Well Logging, Petr. Tech. Vol. 6, No. 2 (March, 1943).

[26] W. F. Cerini, Private communication.

About the Authors

JOHN E. SHERBORNE was born in Leeds, Yorks., England, and in 1920 came to the U. S. and attended the California Institute of Technology, graduating with a B.S. degree in 1934. He subsequently obtained an M.S. degree in petroleum engineering from the University of Southern California and was employed on an API Research Fellowship in chemical engineering. In 1936 he joined Union Oil Company of California as an apprentice engineer and in 1940 he was transferred to the Process Engineering department. In 1944 he was made division production engineer for the Southern Division of California and in 1948 was promoted to chief production engineer.

PAUL W. FISCHER graduated from the University of Southern California with a B.S. degree in 1939, and an M.S. degree in 1940 in the field of organic chemistry. He has since been employed as a research chemist by Union Oil Company of California. His work has been primarily confined to studies of detergents, surface active agents and other organic compounds. From 1940-42 he worked on the development of organic additives for use in motor oils and from 1942-46 on the development of cutting oils, corrosion inhibited oils, emulsifiable oils, antifoams and other specialty products involving the use of special surface active agents and the like. Since 1946 he has worked primarily with drilling fluids.

SECTION ONE
LAST TANK OF CRUDE OIL IN THE WORLD TO BE PRODUCED NEXT WEEK
REVIEWS
U. S. Energy Officials to Attend Final Ceremonies In Saudi Arabia
"Over 150 billion barrels of recoverable oil will remain forever in our presently discovered oil fields... for lack of basic core analysis data from which to develope and maintain adequate engineering control of reservoirs for maximum recovery."

What week of what month of what year? Not in our lifetime, perhaps. But *conservative* estimates indicate that when the petroleum industry closes its books it will be decades ahead of its time . . . billions of barrels short of maximum recovery.

How much recoverable oil will be left behind when your reservoir is abandoned? How much can you afford not to follow a proven program of controlled reservoir performance?

Of all organizations serving the petroleum industry, none offer more direct aid toward obtaining maximum economic recovery than Core Lab. Of all fixed expenditures necessary in the discovery, completion, and production of an oil field, none total less, proportionally, than Core Lab Services.

FOLLOW THE CORE LAB PLAN FOR MAXIMUM RECOVERY

DIAMOND CORING EQUIPMENT: for economical coring and recovery.
DRILL CUTTINGS ANALYSIS: for pin-pointing probable productive zones.
CORE ANALYSIS: for obtaining and interpreting basic reservoir data.
RESERVOIR FLUID ANALYSIS: for maintaining optimum production techniques.
PRODUCTION RESEARCH: for evaluating existing producing properties.
ENGINEERING STUDIES: for planning secondary recovery methods.

CORE LABORATORIES, INC. ● DALLAS, TEXAS

DALLAS HOUSTON CORPUS CHRISTI SHREVEPORT TYLER LAFAYETTE NATCHEZ OKLAHOMA CITY DENVER MIDLAND · ABILENE RANGELY WORLAND BAKERSFIELD CANADA VENEZUELA

"From discovery to maximum recovery."

CORE LAB
PETROLEUM RESERVOIR ENGINEERING

Radioactive and ELECTRICAL Logging

By V. J. MERCIER

Lane-Wells Company, Wichita, Kansas

KNOWLEDGE OF the underlying principles of the "other fellow's" equipment often helps to utilize its results. In this discussion of the basic principles of special types of logging, primarily adapted to geophysicists, the author presents them in non-technical terms for the man on the rig.

SCIENCE has long endeavored to determine the structure of the earth and by the application of laboratory instruments and techniques has been able to secure considerable information on known substances. From the varied geophysical methods available there appeared two that were especially adapted to the surveying of boreholes and their development has been largely the result of the economic stimulus furnished by oil exploration. These methods are designed for the measurement of the electrical characteristics and of radioactive phenomena of the subsurface.

Both methods have passed through an experimental phase and have been accepted by the oil industry as proved scientific tools. The radioactivity log, because it was developed but a few years ago, is perhaps the least familiar. Since the modern petroleum technician employs either one or both of these geophysical methods in the exploration for oil, it is essential that the advantages and limitations of each method be thoroughly understood.

A geophysical tool, used for the surveying of boreholes in the search for petroleum, should be capable of the following:

1. Significant relationship to the nature of the strata.
2. Detection of oil, gas, or certain minerals.
3. Persistence of vertical variations laterally, to provide good subsurface correlations.
4. Operation under almost any borehole condition:
   - (a) Cased holes—dry or filled with fluid.
   - (b) Open holes, dry (cable tools).
   - (c) Open holes, filled with mud or water.
   - (d) Open holes filled with saline fluid.
   - (e) Open holes filled with oil, gas, or oil base drilling fluid.
5. Location of porous strata.
6. Economy of operation.
7. Simplicity of interpretation.
8. Miscellaneous features.

Briefly, let us review the basic principles of both the electrical and radioactivity systems.

Electrical Logs

The usual electrical log is composed of three general types of curves.

(a) Natural or self-potential—a measure in millivolts of the potentials existing between different formations in boreholes. The source of these potentials is commonly attributed to electrochemical and electrofiltration voltages.

(b) Shallow penetration or normal resistivity curve—a measure of the apparent resistivity of the formation adjacent to the borehole and within the zone of borehole fluid invasion.

(c) Third curve (fourth curve, etc.) or deep penetration resistivity curve—a measure of the resistivity of the natural formation beyond the zone of invasion of borehole fluid.

Radioactivity Logs

To date, the radioactivity log is composed of two curves:

(a) Gamma Ray curve (natural radioactivity)—a measure of the relative natural radioactive emission of the adjacent rocks. Because rocks contain some radioactive material, a relationship between the lithology and the radioactivity permits recognition of the strata. Gamma rays will penetrate several inches of steel and cement and, therefore, can be measured through casing.

(b) Neutron curve (artificial radioactivity)—a measure of the secondary emission obtained by subjecting the adjacent formation to a bombardment of neutrons. The magnitude of the secondary radiations is controlled by the amount of hydrogen present in the strata. This is related to the porosity and fluid content of the strata. Secondary emission, also, is measurable through several inches of steel and cement.

Figure 1 illustrates the typical response characteristics of both logs. The drawing is mostly self-explanatory and demonstrates the theoretical response characteristics of each type log, under ideal conditions, to the formations and strata illustrated.

With a working knowledge of both methods of survey, and the response of the various curves to different strata under ideal well conditions, a comparative analysis can be made of the two methods to outline the qualities of each. The following analysis summarizes briefly the advantages and limitations of each method.

1. *Significant Relationship to the Nature of the Strata.* It is generally recognized that continuous coring, with complete recovery, is the only positive means of formation identification. However, this method is costly and not always reliable because of inefficient core recovery. Since all sedimentary rocks contain measurable amounts of radioactive material, and this material has been found to be distributed in a certain relatively systematic manner with respect to for-

mation, the Gamma Ray curve can be said to be definitely a stratigraphic curve.

Interpretation of Curves

The natural or self-potential and the shallow penetration (normal) resistivity curves are used for stratigraphical representation on the electrical log. The neutron and the deep penetration resistivity curves may, under certain circumstances, denote lithology, and are commonly utilized to indicate the characteristics and quantity of connate fluid present.

2. *Detection of Oil, Gas, or Certain Minerals.* The usefulness of either electrical or radioactivity logs in identifying oil or gas bearing zones is dependent on a great many factors, and different methods of interpretation are frequently necessary for various types of producing formations. In limestone areas, the ability of electrical resistivity measurements to denote oil and gas horizons from others is seriously handicapped by the exceedingly high resistivities of nearly all potential producing zones. Only occasionally has the natural or self-potential curve been found to be of help in these areas.

Neither the gamma ray nor neutron measurements has been proved to be directly related to oil or gas content although the latter has been successfully used in determining the oil-gas contact where dry gas is concerned.

Both electrical and radioactive methods, as complete combination logs, provide a quick, inexpensive means for the indirect location of possible producing horizons.

3. *Persistence of Vertical Variations Laterally, to Provide Good Subsurface Correlations.* Both the electrical log and the radioactivity log have sufficient variations for the easy definition of strata, and both are comparatively easy to correlate, even to the extent of correlating one with the other. Possibly the radioactivity log would be the more advantageous in some areas because of the appearance of relatively highly radioactive shales, which are excellent correlative markers.

4. *Ability to Operate Under Almost any Borehole Condition.* The borehole conditions which are suitable for the running of electrical logs are considerably more limited than for radioactivity logs. This results in radioactivity logs being more universally applicable to all types of borehole conditions.

(a) Cased holes—dry or filled with fluid.

Electrical measurement of cased-off

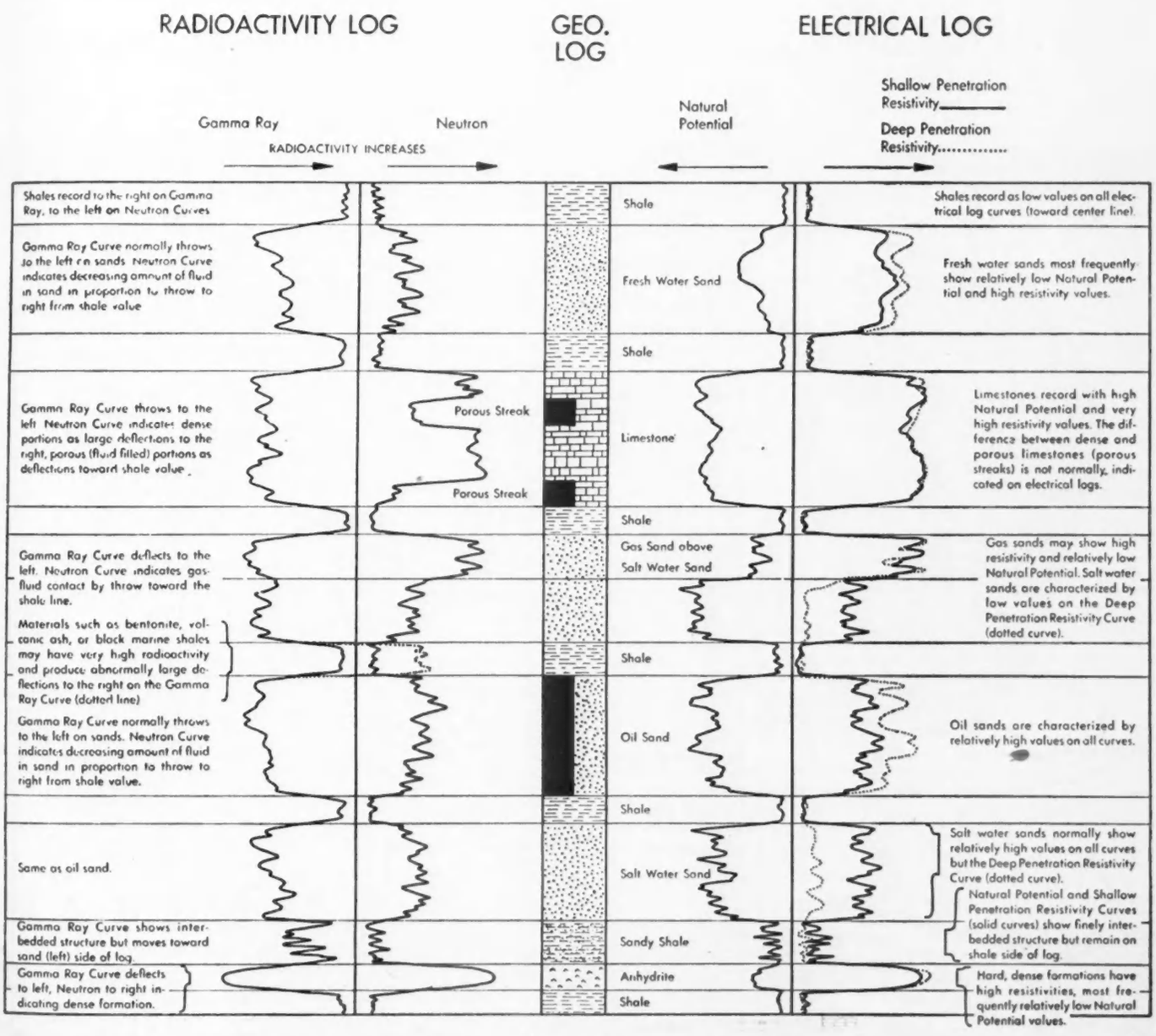

RADIOACTIVITY LOG
GEO. LOG
ELECTRICAL LOG
Gamma Ray
Neutron
RADIOACTIVITY INCREASES
Natural Potential
Shallow Penetration Resistivity
Deep Penetration Resistivity
Shales record to the right on Gamma Ray, to the left on Neutron Curves
Gamma Ray Curve normally throws to the left on sands. Neutron Curve indicates decreasing amount of fluid in sand in proportion to throw to right from shale value
Gamma Ray Curve throws to the left. Neutron Curve indicates dense portions as large deflections to the right, porous (fluid filled) portions as deflections toward shale value.
Porous Streak
Porous Streak
Gamma Ray Curve deflects to the left. Neutron Curve indicates gas-fluid contact by throw toward the shale line.
Materials such as bentonite, volcanic ash, or black marine shales may have very high radioactivity and produce abnormally large deflections to the right on the Gamma Ray Curve (dotted line)
Gamma Ray Curve normally throws to the left on sands. Neutron Curve indicates decreasing amount of fluid in sand in proportion to throw to right from shale value.
Same as oil sand.
Gamma Ray Curve shows interbedded structure but moves toward sand (left) side of log.
Gamma Ray Curve deflects to left, Neutron to right indicating dense formation.
Shale
Fresh Water Sand
Shale
Limestone
Shale
Gas Sand above
Salt Water Sand
Shale
Oil Sand
Shale
Salt Water Sand
Sandy Shale
Anhydrite
Shale
Shales record as low values on all electrical log curves (toward center line).
Fresh water sands most frequently show relatively low Natural Potential and high resistivity values.
Limestones record with high Natural Potential and very high resistivity values. The difference between dense and porous limestones (porous streaks) is not normally indicated on electrical logs.
Gas sands may show high resistivity and relatively low Natural Potential. Salt water sands are characterized by low values on the Deep Penetration Resistivity Curve (dotted curve).
Oil sands are characterized by relatively high values on all curves.
Salt water sands normally show relatively high values on all curves but the Deep Penetration Resistivity Curve (dotted curve).
Natural Potential and Shallow Penetration Resistivity Curves (solid curves) show finely interbedded structure but remain on shale side of log.
Hard, dense formations have high resistivities, most frequently relatively low Natural Potential values.

FIGURE 1. Typical response of radioactivity and electrical logs. These generalized curves illustrate the most typical response of radioactivity and electrical logs to various types of formations. These typical curves should not be used as criteria for the analysis of any particular log since, in practice, a wide range of response may exist.

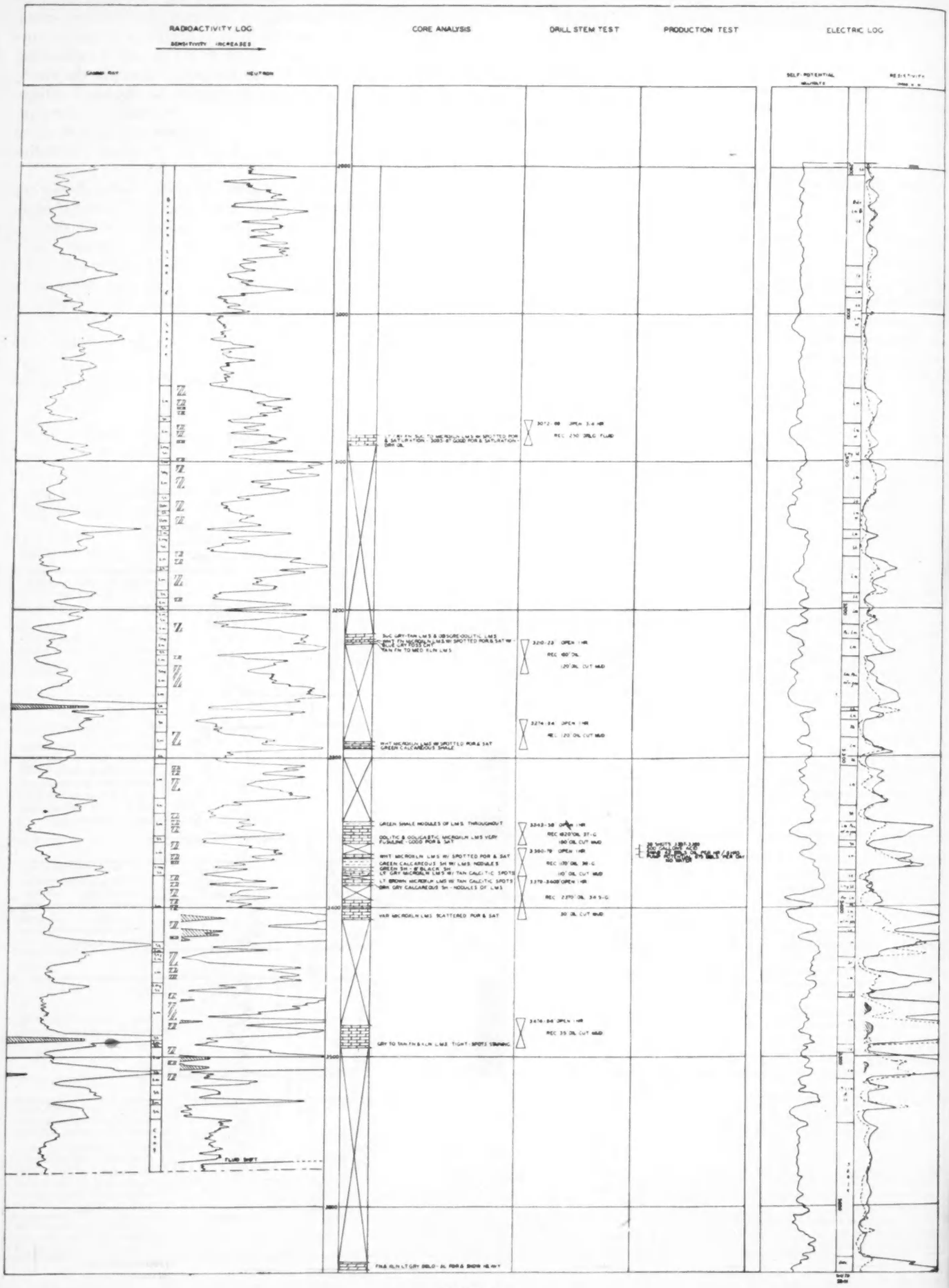

RADIOACTIVITY LOG
CORE ANALYSIS
DRILL STEM TEST
PRODUCTION TEST
ELECTRIC LOG
GAMMA RAY
NEUTRON
SELF-POTENTIAL
RESISTIVITY
FLUID SHUT

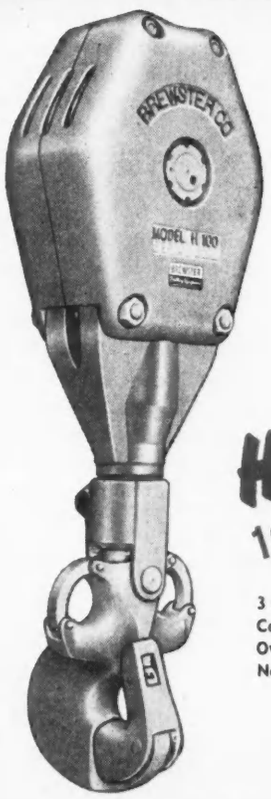
FIGURE 2.

You can lick your SHORT DERRICK PROBLEMS with one of these BREWSTER BLOCKS!

Designed for use in portable rigs and slim-hole derricks, these flat, compact blocks have a fast, free fall. Double tapered bearings; positive individual sheave lubrication. Sheaves have machined, flame hardened A.P.I. grooves. Rugged enough to do the job—light enough for peak efficiency. Write for complete information.

H-50
50 TONS

3 sheaves, 22" dia.
Center pin—3¾" dia.
Overall length—68¼"
Net Weight—1,250 lbs.



H-100
100 TONS

3 sheaves, 30" dia.
Center pin—5⅝" dia.
Overall length—95-13/16"
Net weight—3,400 lbs.

R-430
120 TONS
R-330 — 90 TONS

MODEL R-430
4 sheaves, 30" dia.
Center pin—5⅝" dia.
Overall length—54¼"
Net weight—2,600 lbs.

MODEL R-330
3 sheaves, 30" dia.
Center pin—5⅝" dia.
Overall length—53½"
Net weight—1,800 lbs.

BACKED BY
24-HOUR BREWSTER SERVICE

The BREWSTER Co., Inc.,
Shreveport, La.

APEX EQUIPMENT CO.
BOYAIRD SUPPLY CO.
INDUSTRIAL SUPPLY CO.
MURRAY BROOKS, INC.
REAMS SUPPLY CO.

In Canada:
HALEY SUPPLY CO., Calgary

BREWSTER MATCHED *Drilling Equipment*

formations is, for all practical purposes, impossible. On the other hand, gamma ray emission, neutron bombardment, and secondary radiations are but slightly affected by casing, cement or borehole fluids. It is, therefore, possible to obtain a complete radioactivity log inside a cased hole, either dry or filled with fluid. It was, in fact, the need for a geophysical tool to survey cased holes that brought about the development of the radioactivity log.

(b) Open holes, dry (cable tools).

About the only borehole condition that would satisfy this condition would be a cable-tool well producing gas, and which the operator did not wish to kill with mud. In this instance, an electrical log cannot be employed, except perhaps using contact electrodes. A development known as inductive logging shows some possibilities for this application. However, a survey by radioactive means is available because, as previously stated, the radioactivity log is not affected by the presence or absence of borehole fluids.

(c) Open holes, filled with mud or water.

In mud or waters of proper electrical resistance (from 0.5 to 5.0 ohms), the electrical log functions at its best. It is in wells of this type that the majority of electrical logs are run. Variations in electrical resistance of mud or water, above or below the optimum range, affect the quality of the electrical log adversely. The radioactivity log functions just as well under these conditions as in other borehole conditions.

(d) Open holes, filled with saline fluid.

The quality of electrical logs run in salty drilling fluids is seriously curtailed because the high conductivity of such fluids serves to "short-circuit" the electrodes. Radioactivity instruments, because they are completely independent of any physical contact with the bore, operate equally well in salty fluids.

(e) Open holes, filled with gas, oil, or oil base drilling fluids.

Oil, distillates, and oil-base fluids are insulators and do not conduct electricity. Therefore, electrical contact between the formation and the electrodes of the usual electrical logging device cannot be established. This problem has been largely overcome by the use of contact type electrodes, but these are hampered by hole enlargement and by relatively high contact variations necessitating additional curve smoothing means. Here again, inductive logging may prove of some value. Because the radioactivity is unaffected by fluid, radioactivity logs are readily obtainable under these conditions.

5. *Location of Porous Strata.* Both the complete electrical log and the combination radioactivity log, locate and define porous strata. The self potential in combination with special types of resistivity curves, are used for this purpose in electrical logging, while the neutron curve is the porosity determining curve of the radioactivity logging method. The neutron curve usually gives a more detailed delineation of the strata in limestone areas than does the combination of electrical curves.

6. *Economy of Operation.* The popular use of both the radioactivity and electrical methods of bore-hole surveying is due largely to their inexpensiveness as compared to coring or other methods. Fundamentally, there is very little difference in the basic charges, footage charges, or rigtime. However, in salt contaminated areas, or where oil-base fluids are employed, to obtain a reasonably accurate electrical log it would first be necessary to replace either the salty or oil-base mud with mud of proper electrical resistance. This mud change will necessarily incur added expense in the form of muds and rig time. Under these circumstances it would be more economical to survey by the radioactivity method. As a further consideration in the salt contaminated areas it is possible that the filter-cake and formation infiltration caused by salty mud may create an additional factor in electrical log interpretation. The examination of many representative electrical logs in Kansas fields leads to that contention.

7. *Simplicity of Interpretation.* The gamma ray curve clearly defines strata while the porous zones within the strata are well determined by the neutron curve. Since both curves are relative measurements, there is no need for fixed scales. To obtain maximum value from the electrical curves, consideration must be given to the millivolts deflection of the potential while analyzing the resistivity curves in ohm-meters. In some instances this characteristic requires a very careful analysis of the electrical log to obtain a proper interpretation. This is particularly true in cases where totally different conditions are represented by almost identical responses. Figure 1 indicates several examples of this condition. In general it can be said that each type of log, run under conditions favorable to its qualities, may be readily interpreted by field personnel.

8. *Miscellaneous Problems.* Under this classification would necessarily come a multitude of special problems and applications. Perhaps the most common one to which the electrical log is adapted is the location of the casing seat. The point of contact from the casing to the open hole is well defined by electrical logs. In almost all cases, the neutron curve of the radioactivity log locates this contact point as well as the electrical log and has also the added advantage of locating the seats of outside casing strings, and the tops and bottoms of liners, plus other physical features in the bore. The gamma ray curve is adaptable to permeability studies with the use of radioactive additives, or cement location, also employing radioactive additives.

A feature of the radioactivity log is the relatively new collar log. An electrical device which locates casing collars has been made a part of the gamma ray subsurface instrument. This permits a simultaneous recording of stratigraphy and the casing collars. Future plugbacks or workover operations can then be referred to any point in the well for measurement confirmation, with respect to the desired strata.

Figure 2 is an illustration of a radioactivity log and an electric log which are actual field representations. The radioactivity log and the electric log have been correlated with information obtained in core analysis, drill stem tests and a production test of the well. The positive information obtained from the examination of the cores shows very definitely the lithologic and stratigraphic abilities of both logs to delineate and define accurately the formations encountered. The illustrations point out the ability of the radioactivity log to better differentiate the porous strata. The radioactivity log, since it is not directly limited to oil or gas, of course, can not be used to determine the content of the porous formation. The interpretation placed on each of the logs is the interpretation submitted by the service company. This interpretation should not be construed as the final interpretation since it is made by an individual based upon a rather broad knowledge of an area, whereas, an interpretation made by a technician within the confines of a limited area can be more accurate and detailed and more readily evaluated.

An outstanding feature of the radioactivity well logging method is its ability to obtain a satisfactory log under practically any borehole conditions. Of particular significance in limestone areas, is the clear indication of highly radioactive shales on the radioactivity log and the ability of the neutron log to indicate zones of porosity.

BIBLIOGRAPHY

Radioactivity Well Logging, R. E. Fearon, Oil Weekly, June, 1945.

Electrical Well Logging, Hubert Guyod, Oil Weekly, Fall 1944.

Electrolog Bulletin, Lane-Wells Company.

Electrical Log Interpretation, Hubert Guyod, Oil Weekly, Dec. 1945

Radioactivity Well Logs—Interpretations, V. J. Mercier—Oil Weekly, Oct. '46.

unscrambled, they all say one thing...

Low Cost Per Unit of Work

and that means...

Bethlehem Wire Rope

Ever stop to figure the *real* cost of your wire rope—the cost per unit of work? Do you know, for example, what your rope is costing you for every yard of rock it moves? Or every ton of ore, coal, or slate it hoists? Or every ton-mile in oil-country rotary drilling?

This yardstick—cost per unit of work—is the only *true* measure of wire-rope expense. Purchase price alone is not the answer. The rope with the lowest price tag isn't necessarily a bargain. It's the service life—the total amount of work it will do—that determines your actual cost. That's why we say: specify Bethlehem.

Bethlehem wire rope is a quality product, one carefully and conscientiously built. From the making of the steel to the final reeling and shipping, it is a product that merits your confidence. Because of its long life in service, its cost per unit of work is *low;* it is an economical rope in the truest sense.

Order some today. Check its performance—check thoroughly. We believe you'll soon agree that there isn't a better, more economical rope on the market.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

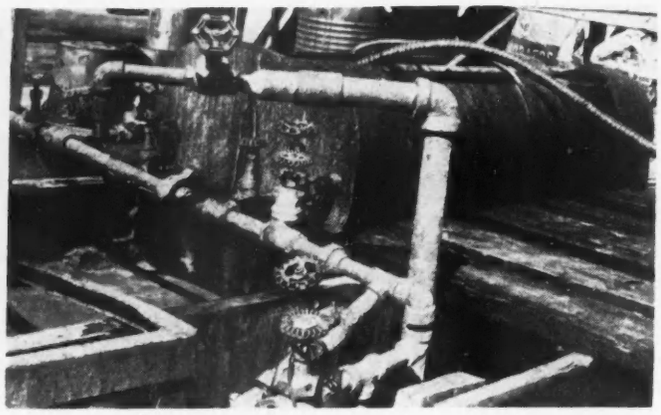
Export Distributor: Bethlehem Steel Export Corporation

How to do it!

DRILLING HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

HOW TO—Mix and Add Drilling Mud Chemicals



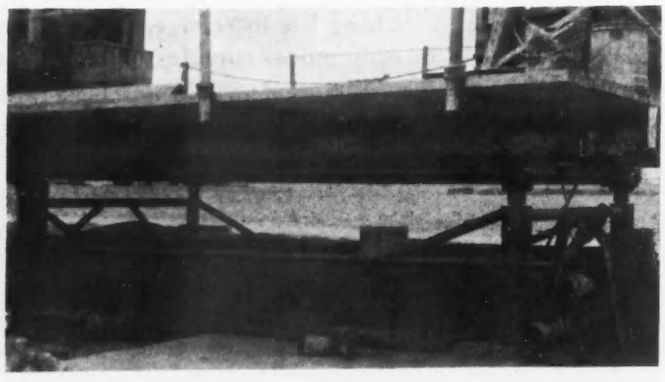
This unitized drilling fluid chemical treating device provides for a method of mixing chemicals not normally found on the average drilling rig. It is unique in that it is made from two sections of 24-inch line pipe which have been closed at each end by a common header piece. Each section is about eight feet long. Another interesting feature is a provision for mixing the chemicals with steam pressure.

Each end plate is square along the bottom edge to support the twin chemical containers. A thin "slice" has been cut from the top edge of the horizontal casing to form a large opening through which to pour the chemicals. This installation, now employed on a Gulf Coast rig, handles caustic soda and quebracho to treat the drilling fluid.

Shale shakers are driven by steam turbines and are furnished steam through a two-inch steam line. A tee and a reducer on this line permit a connection into the header which passes across the front of the two chemical containers. At the opposite end of this header, connections are made into the water line to supply the containers with sufficient water to mix the chemicals. Valves in the line and header provide the necessary blocking to prevent the steam from entering the water system.

Purpose of the steam connection is to provide a means of stirring the contents of each chemical container without adding water. A jet of steam through the contents of each container will stir them sufficiently to make a thorough mixture. A separate valve and nipple connect to the bottom of each container so that the amount of each chemical added to the mud stream can be controlled.

HOW TO—Level Rig Platform with Screw Jacks

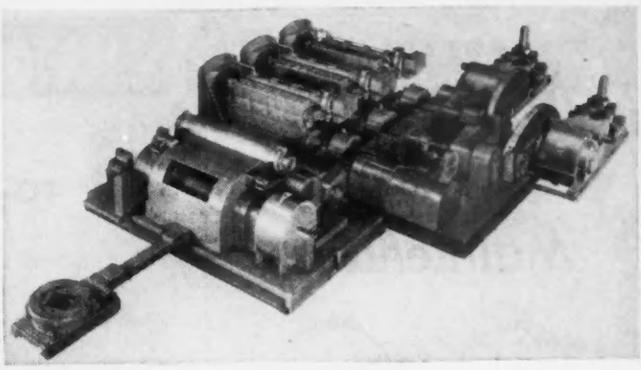


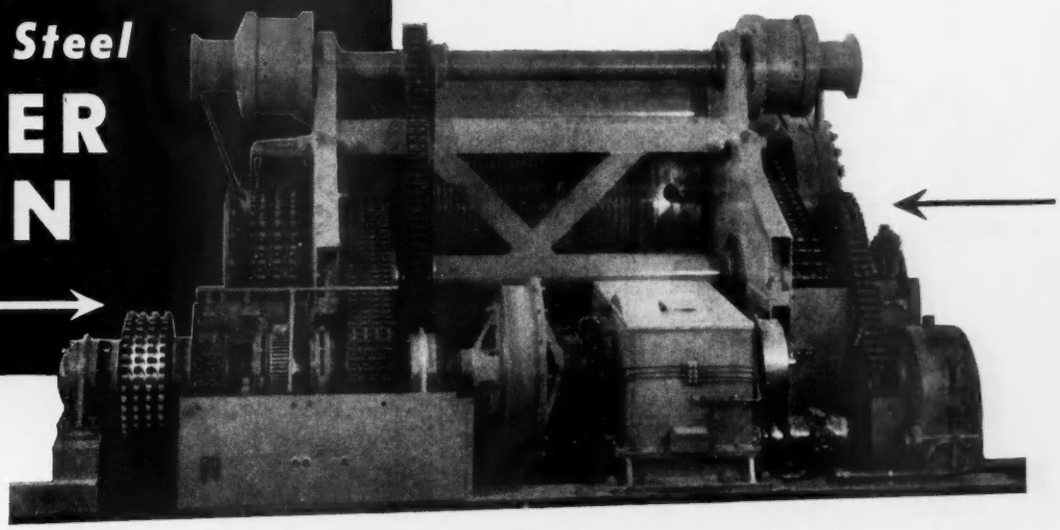
If the surface of the ground is not level enough to place the light drilling rig or cleanout tools in the required position, conventional screw jacks can be adapted to do the job. This rig has a pair of heavy H-beams as the foundation which sets upon timber mats or rig timber cribbing when mats are not available.

The walkway and rack upon which the single joints of drill pipe are laid is a separate structure made of pipe or other material. The longitudinal beams used for the frame are spaced the same distance apart as the heavy structural steel beams which lie upon the timber mats.

Four conventional heavy-duty screw jacks are used with the infeet cut away so the barrels can be attached to the H-beams at each corner of the frame. These barrels are stiffened with connector bars and angle braces so the load will be supported adequately. When one side, or one end is level with the other side, a common jack bar is used to obtain the required degree of leveling without using wedges or small blocks of wood.

SUPERIOR
Breaks Record Again
Rig Equipped with
LINK-BELT
Precision Steel
ROLLER CHAIN





20,521-ft. deep world record breaking Superior Oil Company's Pacific Creek #1 Well was completed in July, 1949. National Supply Co.'s Ideal #160 Rig used on this well is equipped throughout with Link-Belt Precision Steel Roller Chain.

The industry's largest power rig, used on this well, was built especially for drilling tomorrow's deeper holes, and this record well, proves that Link-Belt Precision Steel Roller Chains have what it takes to handle the most difficult of power transmission jobs.

The 2000 H.P., developed by this rig's three engines is compounded through Link-Belt roller chain. Power transmission for the drawworks is equally reliable as a result of dependable Link-Belt chain drives. This rig's two slush-pumps are positively driven with dependable Link-Belt roller chain.

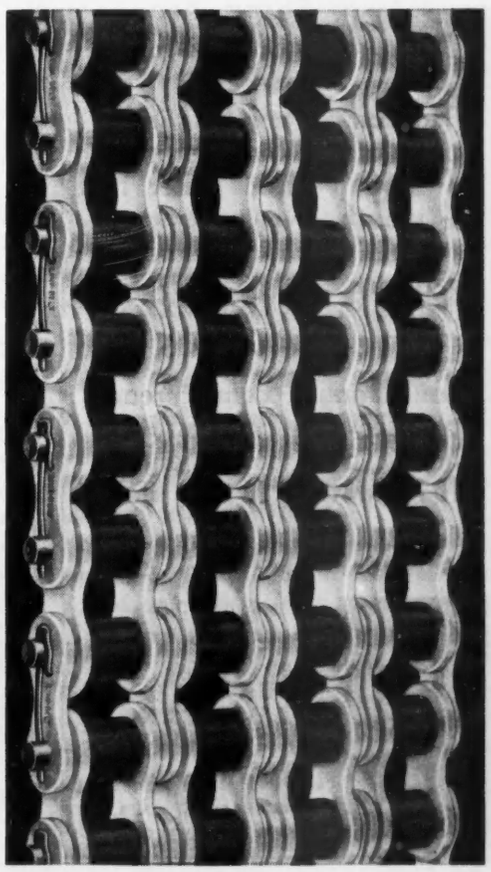
Our engineers will be glad to assist you in solving any power transmission job, without obligation. Just telephone or write us.

➢ E-Z-ASSEMBLY ≺

Link-Belt engineers have developed a construction that makes assembly and disassembly of multiple width chains in the field much easier. With this feature, load distribution across the width of the chain is maintained.

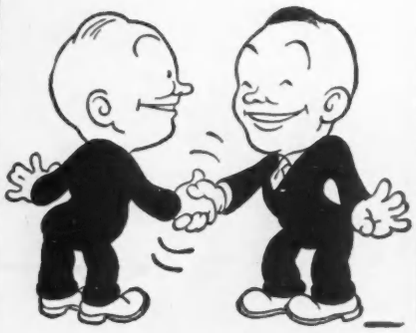
LINK-BELT COMPANY

Indianapolis 6, Dallas 1, Houston 1, Kansas City 6, Mo., Los Angeles 33, New York 7, Toronto 8.
Offices in Principal Cities. 11,005



LINK BELT
Precision Steel
ROLLER CHAIN

Management and Maintenance



Welcome

SAND-BANUM

The Easy and Safe Way

To Remove And Prevent Boiler Scale

Also—There Are No Storage Problems

The can you can hold in the palm of your hand protects 1—250hp rated boiler for 1 month. No bulky containers to handle, store or return.

READY

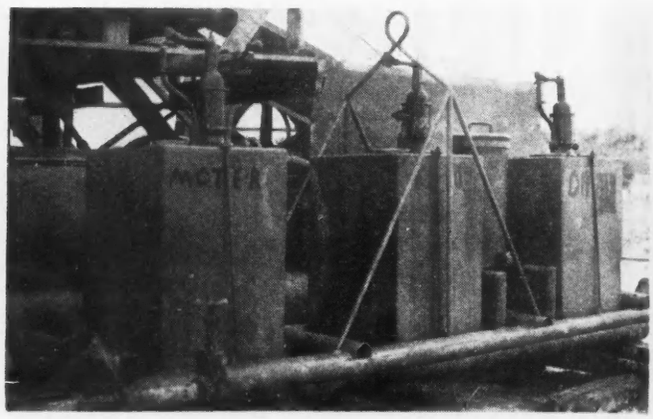
Sand-Banum comes ready to use. That makes it so handy and convenient in the plant or in the field.

WRITE FOR DATA

"The Entirely Different Boiler and Engine Treatment"

AMERICAN SAND-BANUM COMPANY, Inc.
9 ROCKEFELLER PLAZA,
NEW YORK CITY 20

HOW TO—Unitize Lubricant Containers



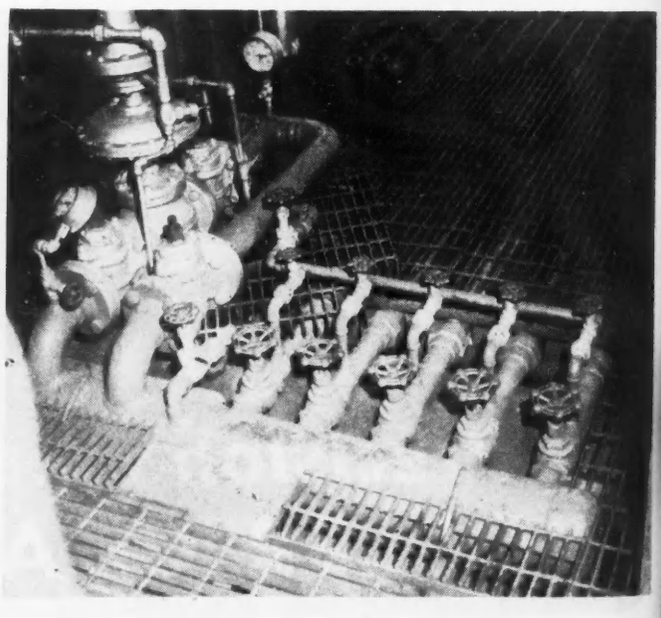
Three filling station type lube oil dispensers can be mounted on a skid base made of pipe so that the entire unit can be lifted from the ground to a truck, or placed in position for use with a truck boom or a rigging machine. The base is made from two parallel joints of pipe, mitre cut and welded to form the upturned tips for ease when skidding. Convenient cross members support a flat floor upon which the dispensers are mounted.

An auxiliary support carries a heavy round can with a friction top for wiping cloths. This container keeps them free of dust and abrasives so they can be used on polished surfaces.

Each of the three dispensers has a conventional hand pump for filling measuring cans when servicing crankcases and the like. So the entire unit can be lifted without delay, a substantial bridle is attached to the cross members terminating with a large ring at the top to connect the hook of a boom chain.

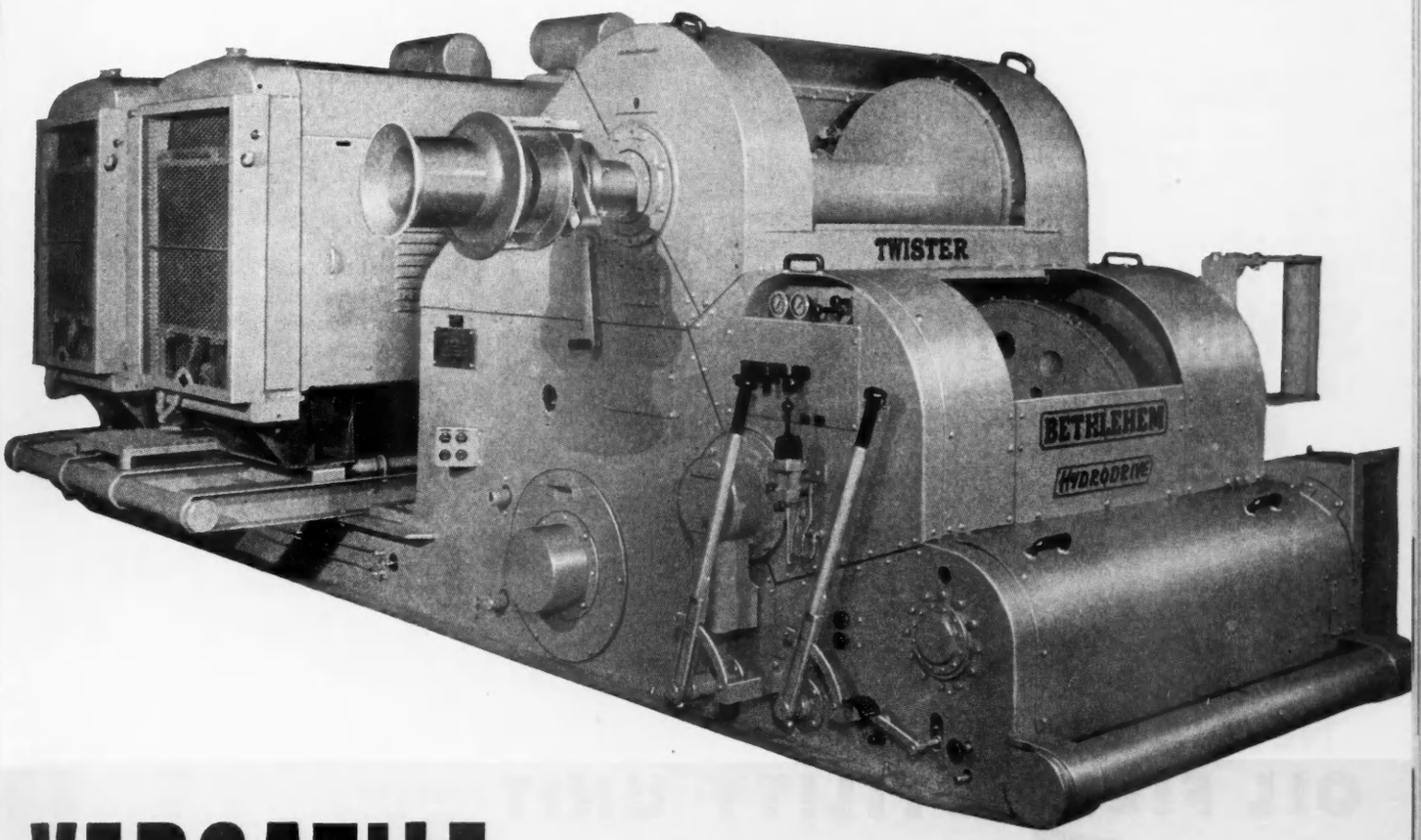
Each dispensing container is held in place by two vertical rods threaded at the top ends. The lower ends are bent at right angles to hook into an eye welded to the pipe skid, while the upper end of the rod bolts to a cross piece which holds the unit securely to the skid.

HOW TO—Arrange Boiler Firing Units

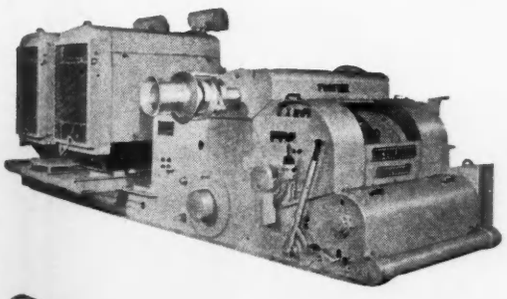


Differing somewhat from the normal boiler firing controls for gas-fueled rigs is this manifold which incorporates flexible manual controls. These valves and manifold serve five 150-horsepower boilers. Natural gas, supplied by the field system, is forced to the boiler burners through a diaphragm - type regulator shown at extreme left. This regulator is controlled by pressure in the

THE BETHLEHEM *HYDRODRIVE* TWISTER



VERSATILE... *and satin-smooth*



For drilling depths ranging from 5,000 to 7,000 ft, and for deepest workover jobs, we spotlight the Twister—give it the full beam with enthusiasm. This is a rig equipped with the smoothest, most shock-free hydraulic drive we have ever offered; a rig completely air-controlled, and so simple to run that the driller can master it in no time at all.

Its smooth flow of power reduces maintenance on clutches, shafts, sprockets, chains, and other moving parts. Shock-loading of drill pipe and other working tools is virtually impossible.

Hydraulic torque-converter drive makes available an infinite number of speeds on the rotary table—and, of course, a full range of drum speeds without constant shifting.

The Twister has many talents. So responsive is the power, so thoroughly under control, that drilling is made easier; workover jobs speeded up. And you should see the gentle way it raises and lowers those portable masts!

Out in the field, where Twisters have been in service for more than a year, there are some mighty pleased owners. It will be worth your while to investigate the reasons.

BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second Street, Tulsa, Okla.

Subsidiary of Bethlehem Steel Corporation

On the Pacific Coast Bethlehem Oil-Field Equipment is sold by Bethlehem Supply Company of California

BETHLEHEM STEEL

main steam header. As this pressure drops below operating values, the regulator opens to furnish more gas to the boilers.

This arrangement is equipped with the standard bypass in the event the regulator must be replaced or repaired. Gas discharges from the regulator into an eight-inch header from which five separate two-inch lines originate. These lines are equipped with globe valves to adjust individual burner supply. When a boiler or boilers are not in service, the valve controlling the supply of gas to the burners can be shut off. Their other function is to facilitate manual control of gas to the burners when the regulator is inoperative.

Unique in this particular hookup is a pilot supply for gas that keeps a pilot fire in the boilers when the regulator shuts off the flow of gas to all boilers. This happens when discharge steam pressure exceeds requirements. The pilot supply, equipped with adequate valves for blocking, etc., taps to the up stream side of the regulator bypass valve, where a steady supply of gas is always available. This pilot supply connects to each boiler gas line on the downstream side of the manual control valve, so that by manipulating the pilot supply valve on each boiler line, the right amount of gas is furnished constantly to maintain a pilot fire.

This system is permanently mounted on a skid with other boiler feed water controls, and is readily accessible for the fireman when manual operation is required.

STEWART & STEVENSON

announces...

a completely

NEW "ALL-ELECTRIC"

OIL FIELD UTILITY UNIT

COMBINATION
RIG LIGHTING PLANT
ELECTRIC WELDER
AIR COMPRESSOR
WASHDOWN PUMP

Here is a completely new *all-electric* utility unit consisting of an engine-driven (either diesel or gas/gasoline/butane) lighting generator, a centrifugal water pump, an air compressor and a built-in welding generator.

ALL-ELECTRIC DRIVE. All accessories are individually driven by splash proof, ball bearing electric motors (of standard make) thus eliminating the necessity of line shafts, pillow block bearings, flexible couplings and line shaft clutches which require lubrication, frequent alignment and many other troublesome service difficulties commonly associated with mechanically-driven units.

GREATER FLEXIBILITY. Since each component is individually driven, the speed of each can be changed without changing the engine speed or interfering with lighting.

LOW FIRST COST. You get all the advantages of an all-electric drive at a price competitive to mechanically-driven units. This low first cost is made possible because of Stewart & Stevenson's streamlined production methods and the experience gained through the manufacture of thousands of engine-driven electric units for every conceivable purpose.

For full information see your nearest Stewart & Stevenson Representative or write to:

STEWART & STEVENSON SERVICES, Inc.

4516 HARRISBURG BLVD. HOUSTON, TEXAS

PARTS • SERVICE
ANYTIME • ANYWHERE

OFFICES IN PRINCIPLE TEXAS CITIES
Also available through leading oil field supply stores.

GM DIESEL POWER

THE NATION'S LARGEST DISTRIBUTORS OF G. M. DIESEL ENGINES

HOW TO—

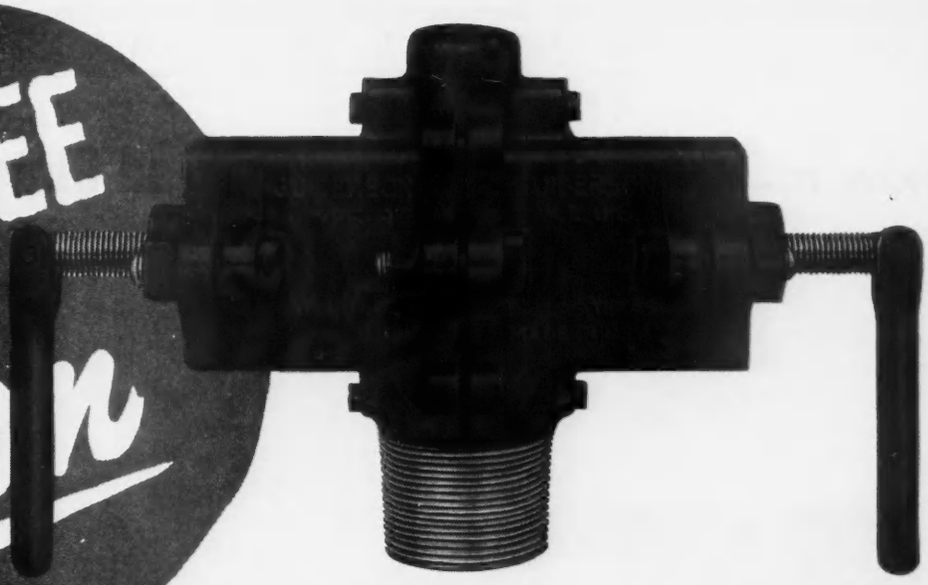
Fix Catline Pulley

One of the easiest methods of stabbing the kelly and swivel into the rathole is to pull them off center with a catline. In using the cathead for this pulling operation, manual strain is removed, and a steady pull can be made so the driller can lower the kelly steadily without bumping the top of the rathole with the kelly sub.

One problem that must be taken into consideration in such a power method is that of deflecting the direction of pull on the catline so the kelly will be pulled over the rathole. With nothing solid enough on which to mount a pulley, one crew erected a vertical anchor post for a small block. It was made of three-inch pipe and bolted at the top to the first girt of the derrick with a heavy U-bolt, and attached to the floor by means of a flange as shown.

An eye bolt passing through the vertical post holds the eye on the block. This device is light and is not used for heavy pulling.

SQEE-GEE Action



WITH THE NEW

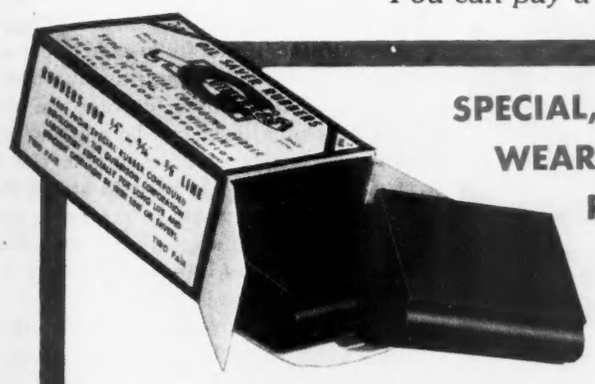
WIRE LINE OIL SAVER

GUIBERSON TYPE "R"

Low initial cost, low upkeep, exceptionally long life and complete dependability—Guiberson's Type "R" Wire Line Oil Saver gives you all of these. Its "squeegee action" gives a high line-squeeze that leaves the wire clean.

The simplicity of installation and operation of the Type "R" make it far easier to install, use and re-rubber than even much more costly wire line oil savers. Made for 2", 2½" and 3" tubing for use on ½", ⅝" and 9/16" wire line.

You can pay a lot more — but you can't buy better!



SPECIAL, LONG-WEARING RUBBERS

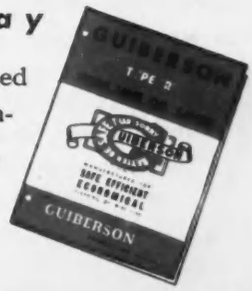
Developed in the Guiberson laboratories for the Type "R," they are resilient yet highly resistant to abrasive wear. *New rubbers are simply inserted behind the old ones—every rubber can be used completely!* Rubbers are moderately priced, packed and identified two pair to the box.

SAFE THAN SORRY — GUIBERSON — BETTER BE

REG. U.S. PAT. OFF.

Write today

for complete, illustrated Type "R" folder containing full information, specifications and prices!



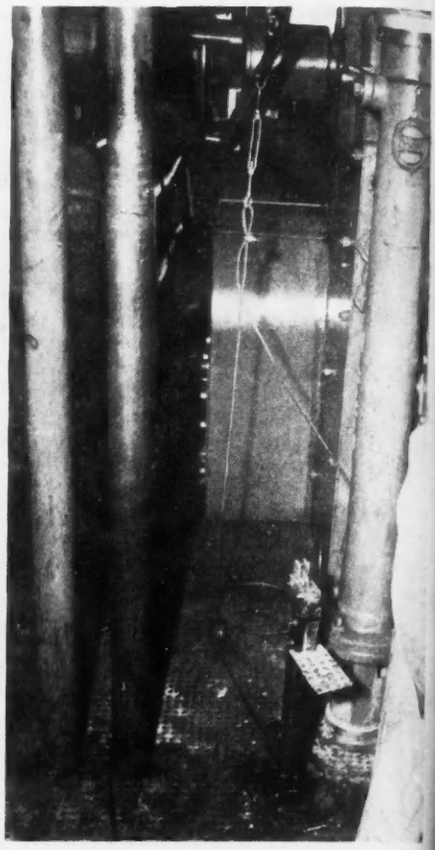
THE GUIBERSON CORPORATION

Dallas, Texas, U.S.A.
Established 1919

Sold by Leading Oil Field Supply Stores Everywhere

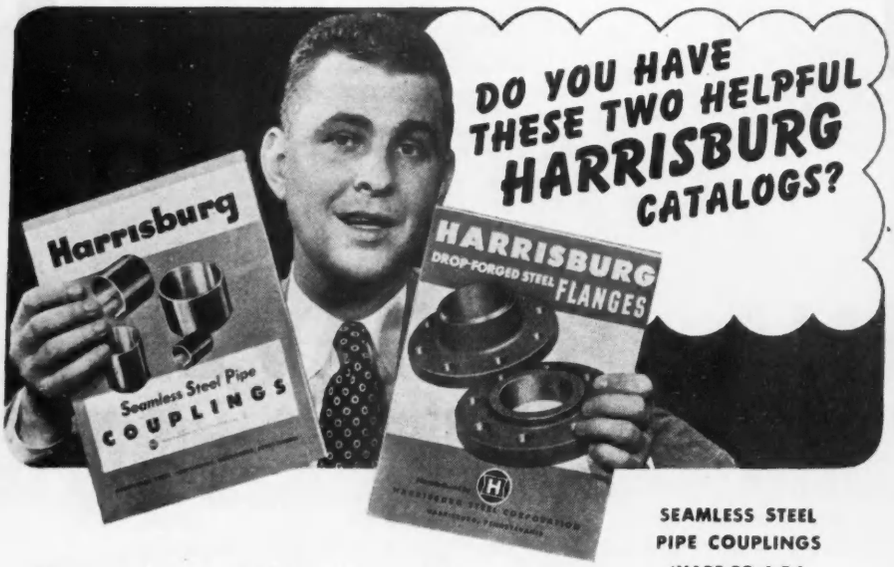
HOW TO—Control Automatic Cathead Clutch with Foot Pedal

An additional factor of safety was added to the job of going in the hole by including this foot-operated device to control the automatic cathead when spinning up pipe. Under normal procedure when adding a stand to the drill stem the driller must use his left hand to engage the clutch of the cathead, while at the same time slackening off on the brake to lower the joint being added. Utilizing this device, the driller is permitted free use of both hands so he can keep one hand on the throttle and the other on the drawworks brake.



A system of pulleys makes it possible for the driller to use his foot in engaging and disengaging the automatic cathead. The desired leverage on the cathead clutch lever can be adjusted by drilling a series of holes in the clutch arm. A turnbuckle is used to attach the small galvanized cable to the lever, and to extend or take up the cable according to the length of stroke necessary to engage the cathead clutch.

A foot pedal is mounted on a vertical beam guide on which the pedal operates. The cable is attached to this pedal and passes over a small pulley supported by the vertical beam. A second pulley on the beam directs the cable to the metal floor where a third pulley transfers the direction of force in a horizontal direction to a point beneath the cathead clutch lever. A fourth pulley, welded to the metal floor, further changes the direction of pull to a vertical direction. By pressing down on the pedal, the driller can cause a similar length of pull down on the clutch lever, thereby greatly simplifying his job when making a round trip and increasing the safety of drilling operations.

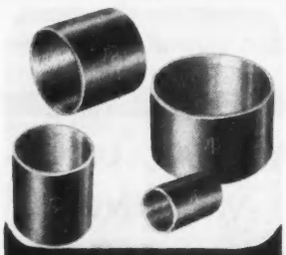


If you don't, send for them right now, while you're thinking about it. They are free—no obligation—and we believe you will find them helpful and informative.

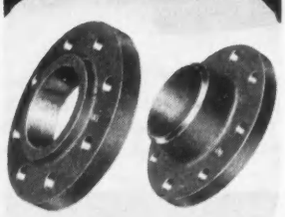
They're chock-full of practical selection tables, charts, and technical information on **Harrisburg** Seamless Steel Pipe Couplings and Drop-Forged Steel Pipe Flanges.

We think everyone interested in these two important items of oil field equipment should have these catalogs on file. Use the coupon, or write us a postcard or letter.

SEAMLESS STEEL PIPE COUPLINGS (MADE TO A.P.I. SPECIFICATIONS)



FIRST BECAUSE THEY'RE FINEST



DROP-FORGED STEEL PIPE FLANGES (MANUFACTURED TO A.S.A. STANDARDS)

SEND THE HARRISBURG CATALOG CHECKED
Harrisburg Steel Corporation, Harrisburg 8, Penna.

( ) *Harrisburg Seamless Steel Pipe Couplings.*
( ) *Harrisburg Drop-Forged Steel Pipe Flanges.*

Name.....
Company.....
Address.....
City..... Zone..... State.....

Harrisburg STEEL CORPORATION
HARRISBURG 8, PENNSYLVANIA

96 YEARS IN PENNSYLVANIA'S CAPITAL

West Texas Drilling Records Broken by "Oilwell" No. 96 Rig

. . . drills 10,024 feet in 38⅛ days in Benedum Field, Upton County

● All fast drilling records in the Benedum Field, West Texas, were recently broken when an "Oilwell" No. 96 Rig on the Warren Wright-C. W. Chancellor No. 1 well drilled 10,024 feet in the official time (less tests and waiting for cement) of 38 days and 3 hours. This is 19 days faster than the next best time reported in the area, which was 57 days for 10,000 feet. A majority of wells in the field take around 62 days. This means the new record beat the average by almost 40%. The well is a producer and was finally bottomed at 11,525 feet.

How do the rig operators account for this great increase in drilling speed? Mr. Herman Aweas, general drilling superintendent for Helmerich and Payne, drilling contractors, says, "We have the best men we could find anywhere. They deserve a lot of credit. Then we backed them up with the best drilling equipment we could buy."

"Oilwell" No. 96 Draw Works with Triple Engine Drive. "This is by far the best rig I've ever used," said Sam Squyres, Driller. "It's faster going in and coming out of the hole. We made a round trip at 6,300 feet in two hours."

"Oilwell" No. 220-P and No. 18-P Slush Pumps. "You're just wasting your time and money if you don't use "Oilwell" Pumps equipped with DI-HARD Liners," says Max Self, toolpusher. "We've used one set of DI-HARD Liners for 24,000 feet and they're not worn out yet."

The "Oilwell" Brantly Rotary Feed Control. This equipment paid for itself two or three times in drilling time saved. It keeps the bit on the bottom for maximum drilling efficiency even when the driller steps away from the controls for a few minutes.

How they did it. The Chancellor No. 1 well was spudded-in April 10, 1949, using an "Oilwell" No. 96 Rig which had already drilled three deep wells in fast time. It was tough going from the very start with shale, limestone, rock and chert all the way down. At 10,024 feet, 73 bits had been used.

4½-inch drill pipe was used in the well. In keeping with West Texas drilling practices, 21-6¼" drill collars, weighing approximately 60,000 lbs. were used.

With the responsive power of the "Oilwell" No. 96, only eight lines had to be strung in the blocks; permitting the establishing of a highly favorable ratio between round-trip time and total drilling time.

Of course, the "Oilwell" No. 220-P Power Slush Pump contributed to this speed record by providing abundant mud circulation at desired pressures.

What's more, the "Oilwell" Brantly Rotary Feed Control kept the feed smooth and constant at all times, probably saving as much time as any other one piece of equipment.

When you can save weeks of drilling time, you save thousands of dollars, too! That's why so many drilling contractors choose "Oilwell" equipment in preference to any other. "Oilwell" equipment is engineered to work together and "Oilwell" Field Service Engineers are on the job constantly to help you keep it running at top efficiency. Next time buy "Oilwell."

"Oilwell" companion equipment to the No. 96 Rig

No. 220-P Power Slush Pumps
No. 500 or 580 Crown Block
No. 400 or 480 Streamline Traveling Block
No. 300-D Swivel (400-ton capacity)
21-A Super Speed or 27½-B Rotaries
Brantly Rotary Feed Control

OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

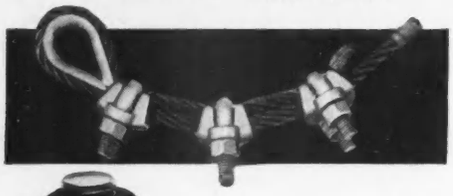
Executive Offices — DALLAS, TEXAS
Export Division Office —
30 ROCKEFELLER PLAZA
NEW YORK 20, N. Y.

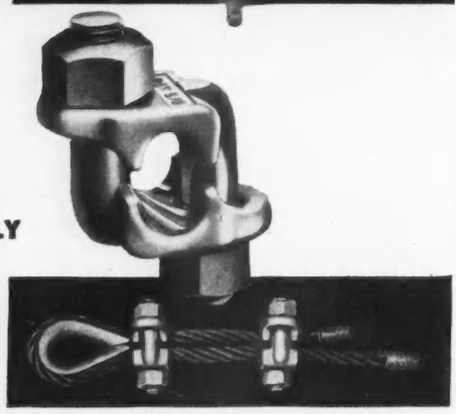
Division Offices — CASPER, WYOMING
COLUMBUS, OHIO . . . DALLAS, TEXAS
HOUSTON, TEXAS . . . TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS "OILWELL"

UNITED STATES STEEL

AVOID THE "FINGER-PINCH"





ONLY

LAUGHLIN

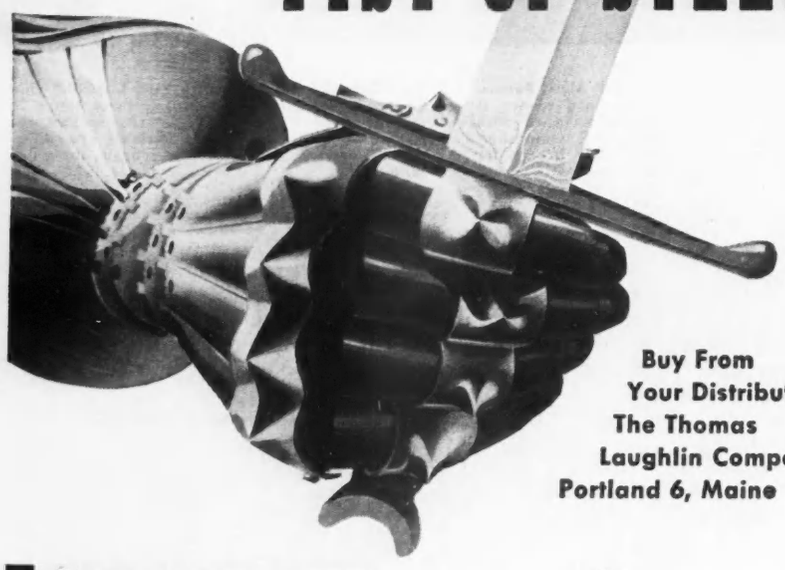
"FIST-GRIP"

SAFETY CLIPS

OFFER YOU ALL THESE SAVINGS:

- Fewer clips required . . . money saved
- No crimped, bowed rope . . . rope saved
- Fewer rope breaks . . . accidents saved
- Easy to put on . . . time saved
- Can't be put on wrong . . . accidents saved
- No battered threads . . . bolts saved
- No special wrenches . . . tools saved

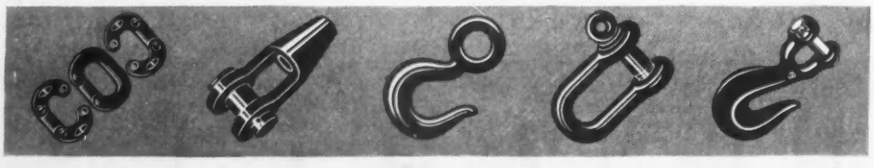
Grip your rope with a FIST OF STEEL!



Buy From Your Distributor. The Thomas Laughlin Company, Portland 6, Maine

LAUGHLIN

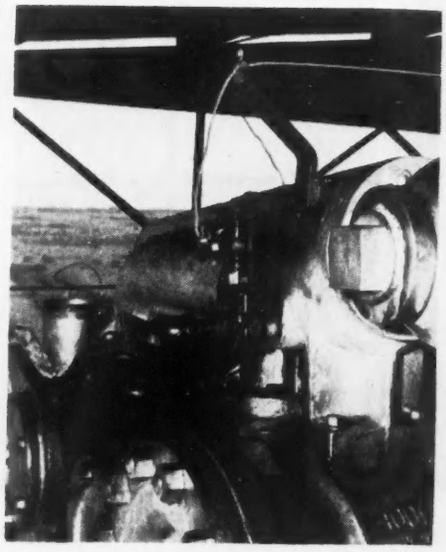
THE MOST COMPLETE LINE OF DROP-FORGED WIRE ROPE AND CHAIN FITTINGS



HOW TO—

Stop Steam Engine

When the throttle valve on steam drilling engines is suddenly closed, the engine first slows down before coming to a standstill. If there is no load on the engine, it will sometimes move very slowly until the steam manifold pressure is lowered to exhaust pressure. In many drilling operations, it is necessary to bring the engine to an absolute standstill in a relatively short time. This requires that the intake manifold be exhausted of steam pressure rapidly.



A small steam exhaust for the intake manifold was added to perform this job. Through a 1¾-inch line, remaining pressure in the manifold after the main throttle valve is closed can be fully exhausted by means of a hand-controlled needle valve. The needle valve is operated by a lever which is connected to a flexible cable terminating at the driller's position. A brace has been welded to the manifold to support a small pulley to transfer the direction of cable pull. The end at the drawworks control is equipped with a pull handle so the driller can easily jerk it when shutting off the throttle. The manifold pressure is immediately exhausted and the engine comes to a complete standstill.

The valve stem lever is equipped with a spring pull down so the valve is automatically closed when the driller releases the pull cord. The remaining steam is exhausted through the cylinder drain system. This device is especially useful when the throttle valve does not make a perfect seal and there is steam leakage around it. Under such condi-

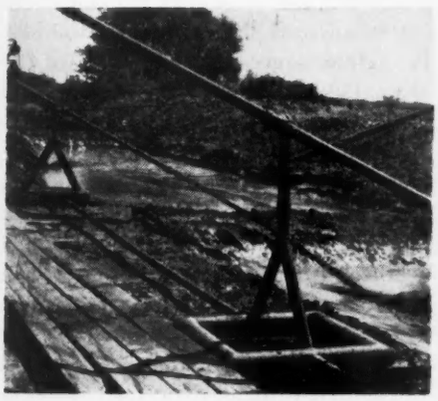
tions, the drawworks engine creeps even though the throttle valve is closed. With this bleed-off valve, any leakage could be exhausted so that it will not cause the pistons to move.

HOW TO—
Connect Mud Guns

Hooking up the mud guns adjacent to the mud pits was simplified by layout of major items of equipment. The mud pumps were located near the boilers about 150 feet from the derrick floor. Two long rectangular mud pits convey the drilling fluid from the shale shakers back to the pumps where it is again picked up and circulated through the well.

To maintain constant agitation in both rectangular pits, two mud guns were employed as shown. Hooking them to the mud supply line was a simple matter since the foundation and support served to bring mud to the gun.

A square framework of three-inch pipe, measuring 30 inches on each side, was welded at the corners to form a continuous chamber inside. A collar was welded to opposite sides of this framework at the midpoint of the side. Several mud guns so equipped could be tied in together by connecting the supplying header to this collar as shown.



To provide adequate support, an inverted Y-shaped mount was made from two-inch pipe and welded to the square framework so that the two lines interconnected. The single riser was fitted with a valve to control the mud flow. An ell and a tee placed in the line at the top of the support provided a means of pointing the gun in any desired direction. Two or three such guns can be used in this type layout. A bull plug in the collar of the foundation shuts off the flow of mud at the terminating gun.

SEISMOGRAPH DRILLERS . . . want more footage at less cost?

Hawthorne Replaceable Blade Bits have by actual tests increased exploration drilling speed by as much as 33 1/3% and decreased bit costs over 50%

"ON THE DRILL" Bit Service

Hawthorne Bits consist of a bit head assembly with three replaceable blades. Replacing worn blades is accomplished in a matter of minutes "on the drill" with tools commonly available. Your supply of 12 sets of blades in a small box shown here weighs only 50 pounds.

One bit head assembly will last for many sets of blades —many of these bit heads have been in service for more than eight months using more than 192 sets of blades per bit.

Patents Pending

"ROCK CUTTER BLADES" for "All-Formation" Drilling

Hawthorne "Rock Cutter" Bits have proved capable of drilling more hole in soft formations in less time than any conventional type drag bit. Furthermore, these blades successfully drill broken formations and many rock formations that have previously required roller bits. This means faster drilling, fewer round trips to change bits and lower bit costs.

The cutter edges of "Rock Cutter" blades consist of a series of fingers so that each edge removes only a small portion of the total hole being cut. The formation is removed in small chips and pieces which are easily circulated to the surface.

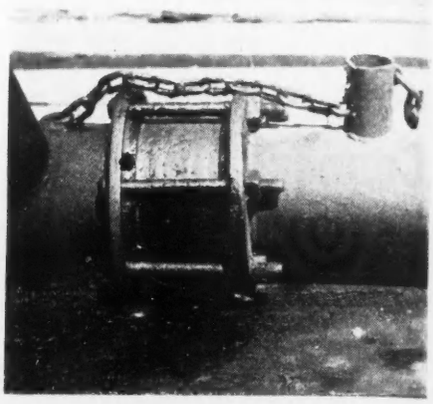
Hawthorne Replaceable Blade "Rock Cutter" Bits are available in a range of sizes to fit any drill. For full information write for our bit catalog today.

HERB J. HAWTHORNE INC.

P. O. BOX 7299 HOUSTON 8, TEXAS

HOW TO—Snub Steam Joints for Connecting Exhaust Lines

Sleeve-type couplings can be used effectively in connecting up steam exhaust lines where pressures are not excessive. These couplings have been particularly useful in the steam exhaust lines from mud pumps to carry used steam to the boiler stacks where forced draft is created. In this type service, some back pressure exists, and it is necessary that joints made up with the sleeve-type coupling be secured against possible breakout.



Since these couplings depend upon a heat-resistant gasket bearing against the steam line for a seal, there is the possibility that one joint of pipe will break away from another joint under pressure due to excessive and prolonged heat and constant vibration.

A snubbing device can be used to add a factor of safety in making up joints on the steam exhaust line when employing this type coupling. It consists of a short section of half-inch chain anchored at one end and secured temporarily in a slot cut into a short nipple welded to the jointing section of exhaust pipe. This slot cut in the four-inch nipple is in the shape of a tee with the cross hole cut in an oval shape. The vertical slot is slightly larger than the width of the chain link and its depth is more than the width of the link.

When making up a joint, the loose end of the chain is threaded through the oval hole and pulled up until the slack is taken from the chain. The nearest link is then dropped in the slot to secure the chain at the other end. In the event the exhaust line should vibrate loose, the chain will prevent it from breaking and possibly injuring a crew member.

Introducing the NEW
IMPROVED CHAMPION
SNATCH BLOCK
Featuring the
SPEED NUT

Fig. 422

New "Speed Nut" eliminates all lower bolts, greatly facilitating opening and closing of block. No bolts to unscrew, pull out and lose. Two quick turns of "Speed Nut" and block is ready to open or close. Nut is never completely removed, and cannot be lost. Hook and clevis quickly interchangeable. For safe working loads up to 25 tons. Made from drop forged, heat treated, selected steel.

Write for Special Bulletin for complete details.

McKISSICK

McKISSICK PRODUCTS CORPORATION
Box 2496 Tulsa, Oklahoma

HOW TO—Condition Mud

A drilling contractor designed and built this unique mud conditioning tank which effectively removes not only well cuttings but fine particles of sand from the drilling fluid. This shop-made device

is between the well head and the mud sump pit. It was tied directly into the mud return line by quick-connecting couplings.

Clean drilling fluid was withdrawn from the tank through a wide-mouthed cone, the upper edge of which was about six inches lower than the top edge of the large circular tank. A four-inch line welded to the bottom of the cone pierced the tank at its center and discharged into the mud pump sump.

The tank, about ten feet in diameter and five feet high, was made from welded sheet metal, and mounted on a wide skid made of four-inch pipe. A semi-circular, concentric wall was

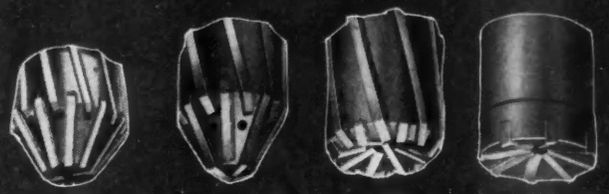
welded to the tank as shown. Bottom edge of this inner wall was welded at the bottom and braced to the tank at the top.

The mud return line entered the tank near its upper edge and tangentially to the tank wall. This line discharges mud into the tank at a point inside the two vertical concentric walls, so that the mud flows half way around the tank between these two confining walls before entering the center of the tank where the mud is relatively quiet.

The path of mud travel allows the cuttings and sand to settle from the fluid before it is decanted through the funnel in the center. A two-inch line connected to the mud pumps provides a means by which the cuttings and sand which accumulate in the conditioning tank can be jetted into the shale pit in the background. A mud gun is also mounted along side the tank to loosen up the cuttings that might pack tightly on bottom and clog the jet.

KINZBACH Whipstocks and Mills-FIRST with oilmen for 24 years

Leading oil operators the world over use Kinzbach Whipstocks for side-tracking, straightening and directional drilling operations. They can be set at any depth, requiring no support for the bottom. Positive setting slips prevent slipping or turning in hole. They can be oriented to mill out in any direction. Patented hinge arrangement assures that top of Whipstock will lie close against pipe walls at all times, permitting easy passage of drilling tools. Setting trigger always locates whipstock between couplings so window will be within one joint. Available in all popular sizes of casing.



Type "A" Mill Type "D" Mill Type "H" Mill Type "I" Mill

Carefully heat-treated high-speed tool steel inserts from the cutting blades in Kinzbach Milling Tools. These inserts, set at most efficient cutting angles in properly shaped, high quality steel bodies provide unequalled cutting action and a uniform depth of cut.

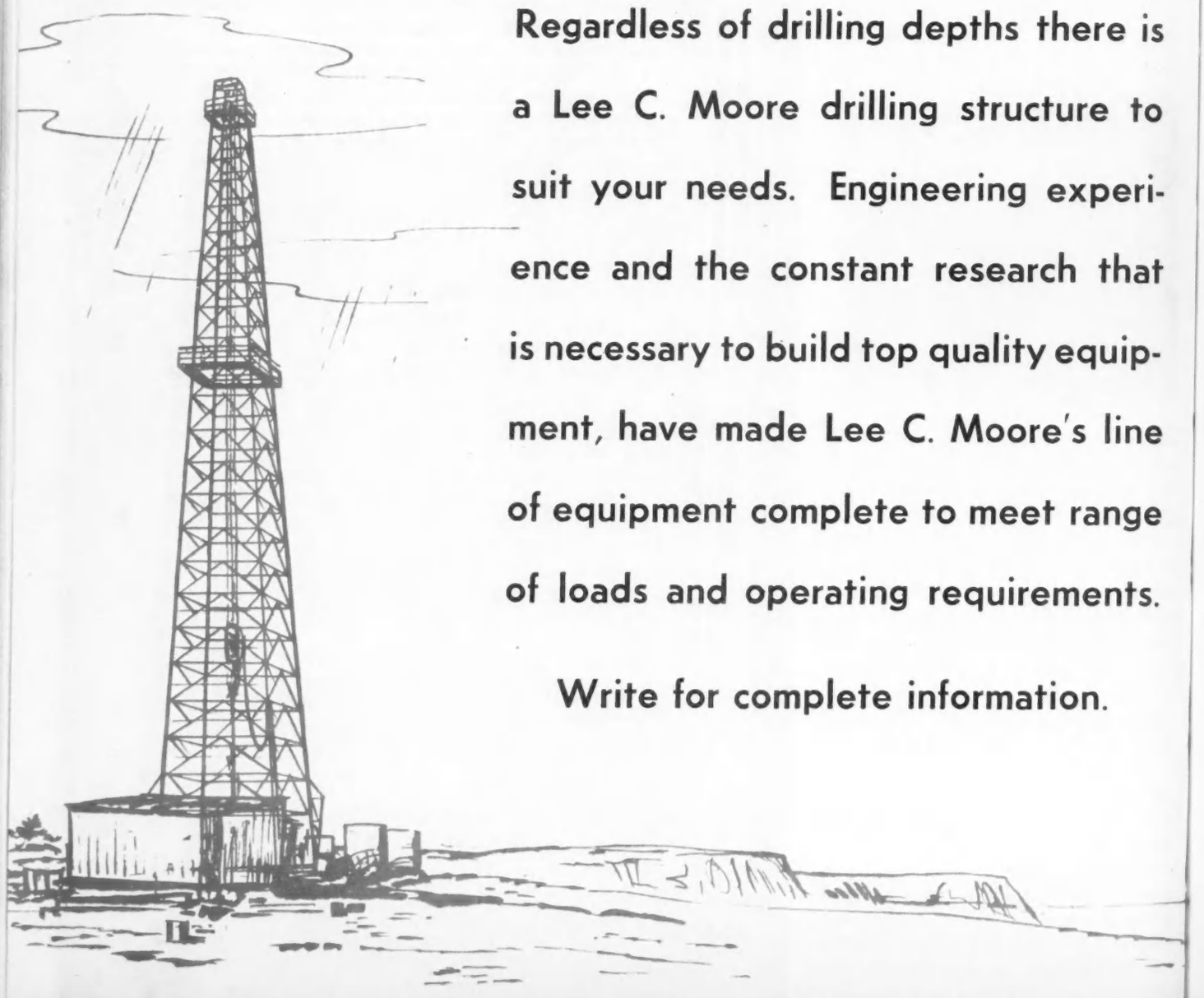
KINZBACH TOOL CO., INC.
P. O. BOX 277 • HOUSTON, TEXAS

KINZBACH TOOL CO INC

Export Office:
74 Trinity Place,
New York, N. Y.

LEE C. Moore EXP

Pays off when drilling 'em..



Regardless of drilling depths there is a Lee C. Moore drilling structure to suit your needs. Engineering experience and the constant research that is necessary to build top quality equipment, have made Lee C. Moore's line of equipment complete to meet range of loads and operating requirements.

Write for complete information.

LEE C. Moore

LEE C. MOORE

TULSA • DALLAS • HOUSTON • MIDLAND

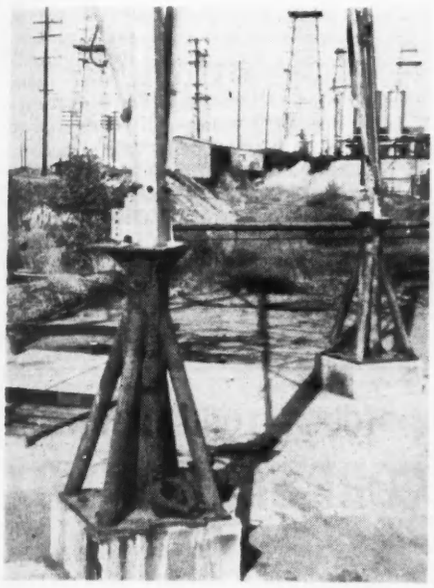
Export Office—

DRILLING HINTS

HOW TO—

Make Derrick Post

If the unitized drilling equipment requires that the derrick be installed on a set of high leg posts, these units can be made without undue difficulty by any competent welder familiar with cutting angles and mitre joints. Such legs left under the last derrick on a drilling project are made with the central post cut from large, heavy pipe set on a square base of boiler plate steel. The cap is made of similar metal large enough in dimensions to match the footing of the derrick leg and having



gusset plates set against the post and under the cap at the four respective corners. These gusset plates are cut from the same type of material of which the cap is made and have all joints adequately welded with enough beads laid down to prevent breaking under the load of the derrick and tools while drilling.

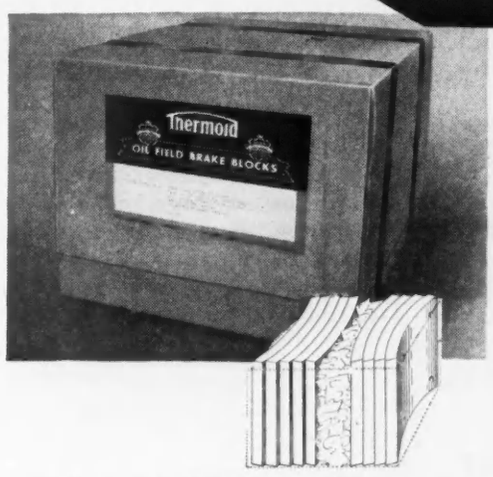
The base is braced with similar gusset plates, four of which radiate from the bottom of the post towards each side of the base and welded securely. Four-inch pipe nipples are prepared, four for each leg, and mitre cut at the top to fit snugly against the center post when the bottom of the pipe nipples is located at the extreme corner of the base. Four holes are cut in the base plate for anchor bolts set in low concrete piers to prevent creep while in use.

An additional advantage in using this type foundation post is that it may be recovered for future locations when the well is abandoned or the derrick moved.

Specify Thermoid

Brake Blocks for ALL Oil Field Drawworks

Thermoid Blocks are accurately formed and jig drilled to fit the unit for which they are intended . . . relining time is reduced to a matter of minutes. Each set is packed with the blocks stacked on edge and so protected that the pre-formed radius cannot be changed or the blocks distorted in shipment. Only enough blocks for one band are packed in a container. Each box is clearly marked with the make and model number of the equipment to be serviced.



No matter what make or model drawworks you use, there is a "Packaged Set" of Thermoid Oil Field Brake Blocks manufactured specifically for your machine. These blocks are designed to provide top operating efficiency and long life, even under the most severe service conditions.

Thermoid Brake Lining is also available in roll lots. All Thermoid Brake Linings are built for the job... built to "feed-off" correctly . . . built to meet your special requirements.

It will pay you to *Specify* Thermoid!

Other Thermoid Quality Oil Field Products: Wire Line Turn Backs • No Wip Line Savers • Stuffing Box Rings • All types of Hose • Molded Specialties • Powerflex Rotary Hose • Mud-Flo Slush Pump Hose • Flexible Discharge Units • Brake Blocks

Thermoid Company

Western Offices and Factory • Nephi, Utah, U.S.A.
Main Offices and Factory • Trenton, N. J., U. S. A.
Industrial Rubber Products • Friction Materials • Oil Field Products

Serving With

Distinction

HELDT

HELDT

TRUCKS

★ TRUCKS

★ TRACTORS

★ BULLDOZERS

★MOTOR GRADERS

Winch and Crane Equipped

SERVING TEXAS OIL FIELDS

with

COMPLETE and COMPETENT
OIL FIELD SERVICE

Since 1928

HELDT BROS., TRUCKS

P. O. Drawer 1130 Alice, Texas

ALICE Phone: 1376 | FREER Phone: 66 | SULLIVAN CITY Phone: 11

Statewide I. C. C. and R. R. C. Certificates

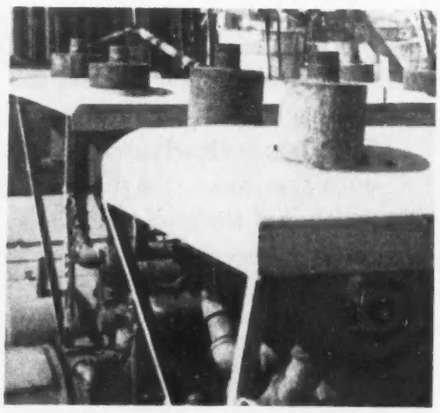
DRILLING HINTS

HOW TO—

Make Engine Cover

To eliminate the conventional structure commonly employed to house the drilling engines, each unit can be fitted with an individual cover which protects the engine from rain storms when a well is being drilled, and serves as protection when the engines are stored in the warehouse yard. These covers are made of sheet metal, approximately the weight and thickness of ordinary tank decks, trimmed to a size with adequate overhang so rain will not drip on magnetos or fuel mixers and carburetors.

Main deck of the roof of these covers is almost flat with holes made so the



exhaust pipes or mufflers will extend through them. Sufficient space is left between the muffler and deck to compensate for vibration or misalignment. A narrow rim welded to the cover around the opening prevents run off from trickling down into the area below the cover.

Edges of the cover may be turned down to form a narrow wall below the eaves, or a narrow strip may be welded to the cover to serve the same purpose.

The cover is supported above the engine with angle iron standards attached to the corners of the cover and connected to the engine at the most suitable place. On some of the covers, a narrow gutter is attached to the outside edge to carry rain water away to the corners to protect equipment at the side of the engine.

Minor engine adjustments can be made easily without disturbing these fixed covers. When the engine must undergo a major overhaul, it is necessary only to unbolt the supporting brackets and remove these covers entirely.

Simplex
HYDRAULIC JACKS

Dependable performance, day after day on difficult jobs, produces reports like these from Simplex Hydraulic users. Engineered for faster, safer jacking, these jacks include such features as leakproof high pressure seals of Neoprene; non-sticking ball valves; smooth acting ram of SAE X1112 steel — plus many others. Eight models; capacities from 3 to 100 tons — all safety-tested to 50% over rated capacity.

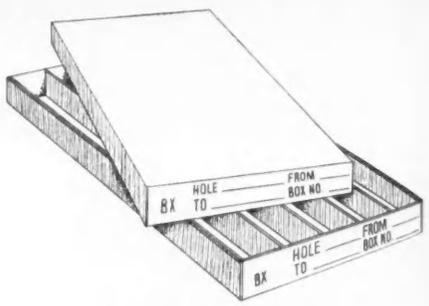
SEND FOR BULLETIN: HYDRAULIC 49

Simplex
LEVER • SCREW • HYDRAULIC
Jacks

TEMPLETON, KENLY & COMPANY
1032 So. Central Ave., Chicago 44, Illinois

TOUGH, LONG LASTING

CORE SAMPLE BOX



Approved by USGS and Major Oil Companies

Made of 200 lb. test corrugated board, the Love Core Sample Box gives the best protection for your wet or crumbling samples. Box ends are double stitched to withstand rough handling and shipping. Partitions are firmly anchored. Filing record is printed on both box and lid. Available for any size samples. Send for price list and delivery date.

The Love Box Company

608 COMMERCE WICHITA, KANS.

Notes on Galvanic Corrosion

By F. L. LAQUE and W. D. MOGERMAN
Corrosion Engineering Section, International Nickel Company

THE AUTHORS develop the theory of bi-metallic corrosion, and show the relative intensity of corrosion as various metals or alloys are placed in conditions where electrolytic action is possible. Recommendations as to choice of metals are made, with emphasis on one-metal construction wherever possible.

GALVANIC corrosion may be defined as the accelerated electrochemical corrosion produced when one metal is in electrical contact with another more noble metal, both being immersed in the same corroding medium, which is called the electrolyte. Corrosion of this type results usually in an accelerated rate of solution for one member of the couple and protection for the other; the protected member, the one that does not corrode, being the nobler metal. Note that as galvanic corrosion is generally understood it consists of the total corrosion, which comprises the normal corrosion that would occur on a metal exposed alone plus the additional amount that is due to contact with the more noble material.

During the corrosion process an electric current is generated by the two metals in contact, and the magnitude of this current is equivalent to the acceleration of the corrosion of the more vulnerable material beyond its normal rate. The general reaction is similar to that of a miniature cell, or battery, from which a finite amount of electrical power may be derived. The simplest and best known example of such a galvanic cell is the one composed of strips of zinc and copper joined by a metallic conductor and immersed in a dilute solution of sulfuric acid. It is well known that in this cell the less noble zinc strip suffers accelerated corrosion, while the more noble copper is virtually unattacked.

Galvanic Series

With a knowledge of the galvanic corrosion behavior of metals and alloys, it is possible to arrange them in a series which will indicate their general tendencies to form galvanic cells, and to predict the probable direction of the galvanic effects. Such a series is provided in Table 1.

This table is based on actual corrosion testing experience with numerous corrosives in the laboratory, under plant operating conditions, and on practical results with metals and alloys in long service. This series should not be confused with the familiar "Electromotive Series," which is found in many textbooks and is of value in physical chemistry and thermodynamic studies. Let us make this difference a little clearer. The metals in the "Electromotive Series" are arranged according to the potentials possessed by them when immersed in solutions of a definite strength. These solutions are theoretically made up in a concentration containing one mole per liter of the same ions as the respective metal immersed in it. The solutions, in other words, must possess an activity of unity. This fact must be borne in mind in using the "Electromotive Series." It is of great theoretical value, but it cannot be relied upon to predict the potential differences between metals in the general case. And it certainly cannot be used to predict the amount of accelerated corrosion that will result from contact between two metals. Table 1 has basic characteristics which make it analogous to the "Electromotive Series," but it also takes into consideration over-all and practical aspects in addition to theoretical principles. The potentials measured in these practical corrosive environments do determine which one of two metals will be anodic and which cathodic —less or more noble.

It will be noticed that some of the metals in Table 1 are grouped together. These group members have no strong tendency to produce galvanic corrosion of each other, and from the practical standpoint they are relatively safe to use in contact with each other. But the coupling of two metals from *different* groups and *distant* from each other in the list will result in galvanic, or accelerated, corrosion of the one higher in the list. The farther apart the metals stand, the

TABLE 1
Galvanic Series of Metals and Alloys

Corroded End
(anodic, or least noble)

Magnesium
Magnesium alloys
Zinc
Aluminum 2 S
Cadmium
Aluminum 17 ST
Steel or Iron
Cast Iron
Chromium-iron (active)
Ni-Resist
18-8 Stainless (active)
18-8-3 Stainless (active)
Lead-tin solders
Lead
Tin
Nickel (active)
Inconel (active)
Brasses
Copper
Bronzes
Copper-nickel alloys
Monel
Silver solder
Nickel (passive)
Inconel (passive)
Chromium-iron (passive)
18-8 Stainless (passive)
18-8-3 Stainless (passive)
Silver
Graphite
Gold
Platinum

Protected End
(cathodic, or most noble)

FIGURE 1

FIGURE 2

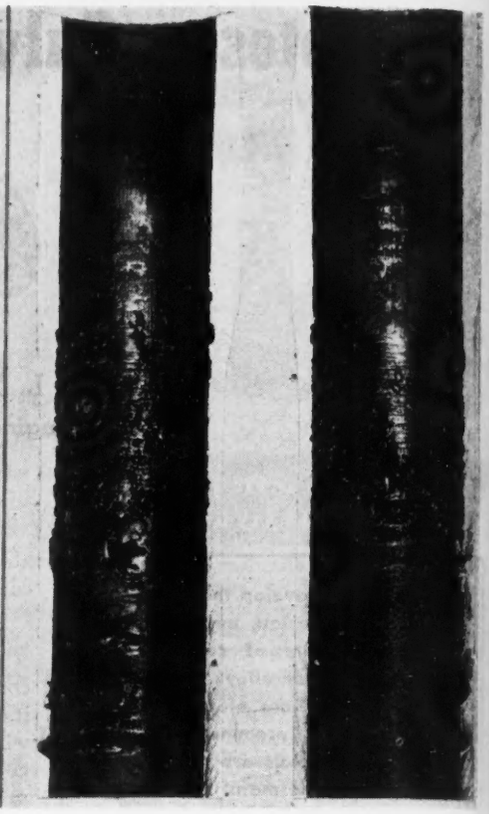


FIGURE 3

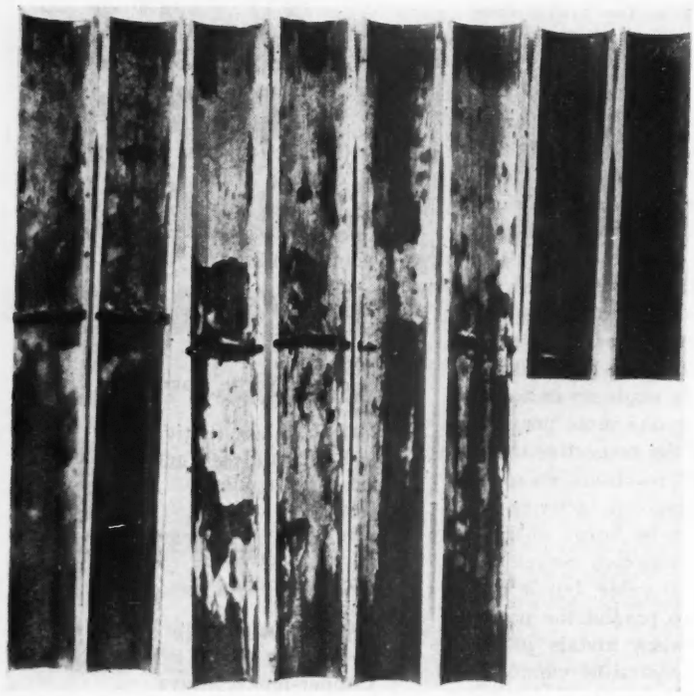


FIGURE 4

FIGURE 1. Hard-facing alloy material on special purpose couplings which caused galvanic corrosion of the base metal.

FIGURE 2. Plated pump plunger which failed due to galvanic attack concentrated at breaks in the plating.

FIGURE 3. Galvanic corrosion of 5 percent nickel tubing concentrated at breaks in the mill scale coating.

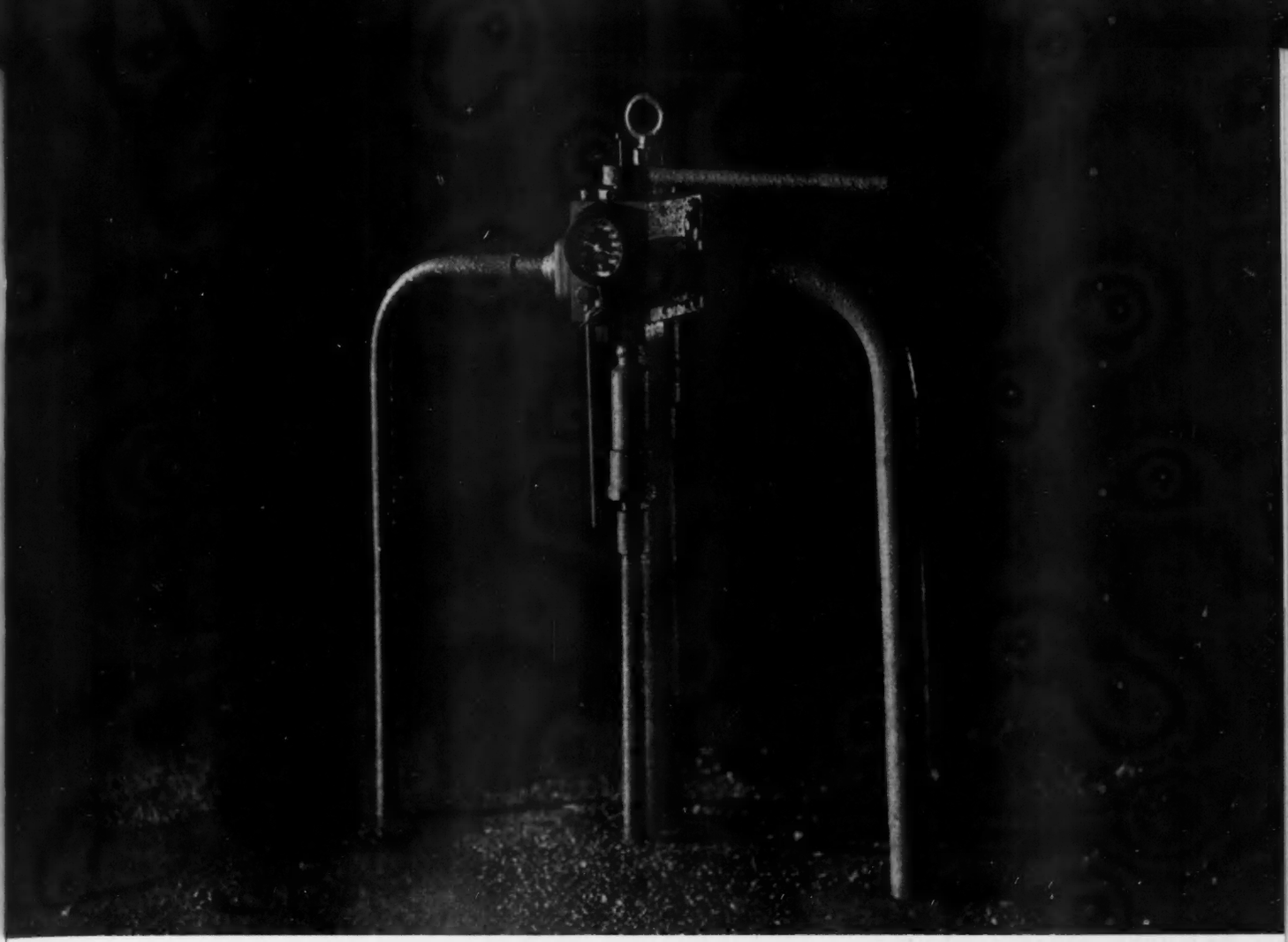
FIGURE 4. Galvanic corrosion of tubing due to differences in physical structure as a result of improper normalizing.

greater will be the galvanic tendency. This may be determined by measurement of the electrical potential difference between them, and this is often done. But it is not practical to tabulate these differences, because the voltage values for combinations of the metals will vary with each different corrosive condition. What actually determines galvanic effect is the quantity of current generated, rather than the potential difference.

The relative position of a metal within a group sometimes changes with external conditions, but it is only rarely that changes occur from group to group. It will be seen that the chromium-iron and chromium-nickel-iron alloys (stainless steels) are in two places in the table. They frequently change positions as indicated, depending upon the corrosive media. The most important reasons for this are the oxidizing power and acidity of the solutions, and the presence of activating ions, such as halides. Inconel and nickel also occasionally behave in a similar manner, though the variations of their position are less frequent and less extensive.

The galvanic series indicates only the

■ CONTINUED ON PAGE 158



HOW MUCH IS *Weather* COSTING YOU?

A cost that is seldom entered on the ledger in adding up the expense of lifting oil—is the cost of the weather. Yet it is always there! Rain, sleet, snow, floods—all add to the cost of putting oil into the tanks . . . cost in time . . . cost in production . . . cost in money.

The operators who are today experiencing the lowest possible weather costs are those who are operating Kobe Hydraulic Free Pumping systems.

Free Pump wells keep right on producing regardless of the elements . . . even when the wellhead is completely submerged by flood waters. Controlled from central power plants that can be located for greatest accessibility and protection, Free Pump wells are not subject to weather interference.

In the event that the bottom hole pump in any Free Pump well needs changing, there's no waiting for equipment. No rigging up or tearing down time. So long as one man can reach the wellhead, a new Free Pump can be brought in. One man, alone, can surface, change and run in the bottom hole pump. Your well, regardless of the weather, is off production only the short time it takes to circulate the Free Pump in and out of the well.

Cut your weather costs by changing over to Free Pumping! Know freedom from worry over lost production and downtime! Your local Kobe representative has case histories of the all-weather performance of Free Pumping that will show how you can lower your pumping operating costs.

Free Pump

KOBE

ONE OF THE DRESSER INDUSTRIES

KOBE, INC. *General Offices:* Huntington Park, Calif. *Division and District Offices:* Avenal, Bakersfield and Ventura, Calif.; Rangely, Colo.; Ardmore, Oklahoma City and Tulsa, Okla.; Brownfield, Corpus Christi, Fort Worth, Houston, Longview, Odessa, and Wichita Falls, Texas; Brookhaven, Miss.; Hobbs, N. M.; Great Bend, Kansas; New York City.

THESE ARE THE DAYS OF FREE PUMPING

Pressure Drop for Oil-Gas Mixtures in Horizontal Flow Lines

By N. VAN WINGEN
Vice President, Petroleum Technologists, Inc.

IN THIS paper a comparison is made between analytically derived and empirical pressure drop data for flow of oil and gas mixtures in three-inch flow lines. A generally satisfactory agreement is noted.

AN IMPORTANT consideration in conjunction with the development of a new oil lease or property is the design of adequate flow lines to transport oil and gas simultaneously from well to tank farm. It is important that such lines be of sufficient diameter so that the pressure drops will not be excessive. Likewise their size should be held to the minimum practical in order to reduce capital expenditure.

Problems dealing with single-phase one-component flow lend themselves to ready analysis on the basis of various empirical flow formulas available in the literature such as Weymouth's equation for the flow of gases or the Chezy-Darcy formula for the flow of liquids. The problem of two-phase two-component flow however, is far more complex and yet it is the latter type problem which is most generally encountered in oil field practice. A considerable amount of experimental work in the field of two-phase flow has been reported in the literature. The majority of these data, however, do not lend themselves readily to direct application to the problem of flow line design and it was not until 1944 that a comprehensive paper was published by Martinelli and co-workers[1] on the subject. These authors suggested a simple and direct method of calculation for four types of flow regimes, as follows: 1. Liquid and gas both flowing turbulently, 2. Viscous-liquid flow and turbulent gas flow, 3. Both liquid and gas flowing viscously, 4. Turbulent liquid flow and viscous gas flow. Actual experimental data were included for cases 1 and 2. In 1946 Martinelli and co-workers[2] presented additional laboratory data pertaining to case 3. Prior to the time of publication of these two important papers a large amount of empirical pressure drop data for three-inch flow lines was compiled by the author under conditions of actual oilfield operation. Observations extended over an approximate two year period and involved 175 usable determinations for rates of oil flow ranging from 59 to 1200 barrels per day and gas-oil ratios ranging from 1200 to 11,000 cubic feet per barrel. Flow line lengths ranged from 425 to 3000 feet and were essentially without difference in elevation. It is the purpose of this paper to compare pressure drops as computed by the method suggested by Martinelli and co-workers[1,2] with those obtained empirically under the actual oilfield conditions of operation, and secondly to present the empirical data for ready reference in terms of oil field units of measurement.

Experimental Field Data

Flow line pressures were recorded with a test gauge downstream of the flow bean at the wellhead and at the approximately 450 pounds per square inch gauge high-pressure separator at the tank farm. Detailed compositional data for the respective phases of the well effluents were not available, nor was it feasible to accurately determine the average flow line temperatures. However, the crude oil from the majority of the wells had a gravity of approximately 36 degrees API while the high-pressure separator gas had an average specific gravity of 0.65 (Air = 1). The average flow line temperature was found to fluctuate not more than approximately 20° F. as between summer and winter with an average yearly temperature of approximately 90° F. being indicated. The majority of the field data were recorded purposely during the fall months and in early spring in order to avoid periods of either maximum or minimum temperature conditions. A few observations made during the summer months were generally found to give respectively higher pressure drops than those taken at lower temperatures. This behavior is to be anticipated in view of the greater volume occupied by unit mass of either liquid or gas. Thus, while these experimental data are not commensurate in accuracy with those generally obtained under laboratory conditions of flow they are believed to be representative for the average conditions as indicated. Furthermore the fluctuations of the respective variables are not sufficiently large to warrant the separate treatment of certain portions of the data.

Results Obtained

Reynolds numbers computed for the lowest rates of oil and gas flow encountered when the empirical field data were compiled were of an order of magnitude to indicate that both the liquid (oil) and the gas were in turbulent motion. Thus, theoretically derived pressure drops for flow were computed using Martinelli and co-worker's[3] equation for this type of flow mechanism. The corresponding equation may be summarized as follows:

$$\text{Reynolds modulus} = \frac{4}{\pi} \cdot \frac{W}{D\mu g}$$

where:

- W = weight rate of fluid lb. per sec.
- D = inside diameter of pipe ft.
- μ = absoiute viscosity of fluid lb. sec. per sq. ft.
- g = gravitational force per unit mass

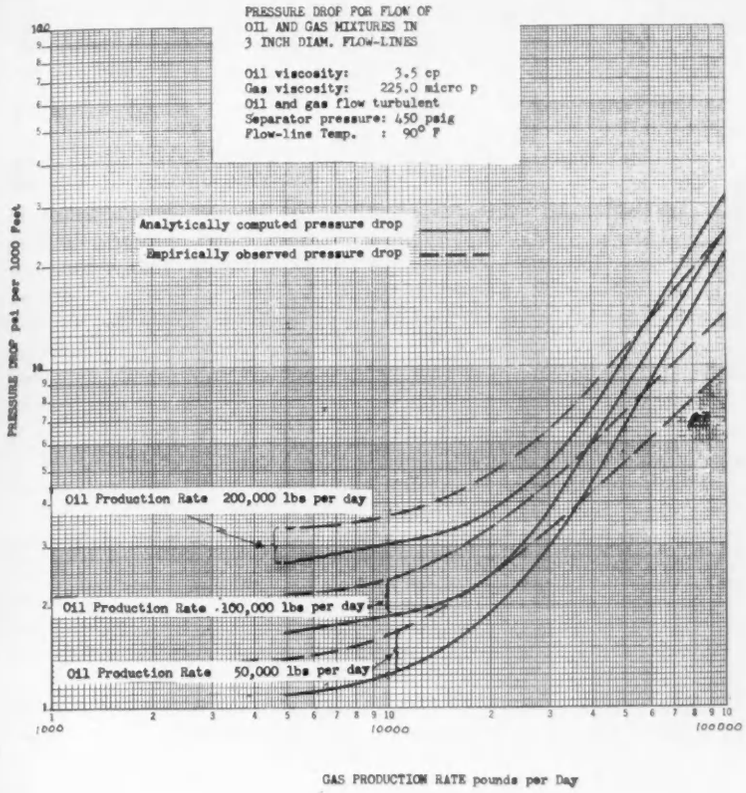

PRESSURE DROP FOR FLOW OF
OIL AND GAS MIXTURES IN
3 INCH DIAM. FLOW-LINES
Oil viscosity: 3.5 cp
Gas viscosity: 225.0 micro p
Oil and gas flow turbulent
Separator pressure: 450 psig
Flow-line Temp. : 90° F
Analytically computed pressure drop
Empirically observed pressure drop
Oil Production Rate 200,000 lbs per day
Oil Production Rate 100,000 lbs per day
Oil Production Rate 50,000 lbs per day
PRESSURE DROP psi per 1000 Feet
GAS PRODUCTION RATE pounds per Day

FIGURE 1

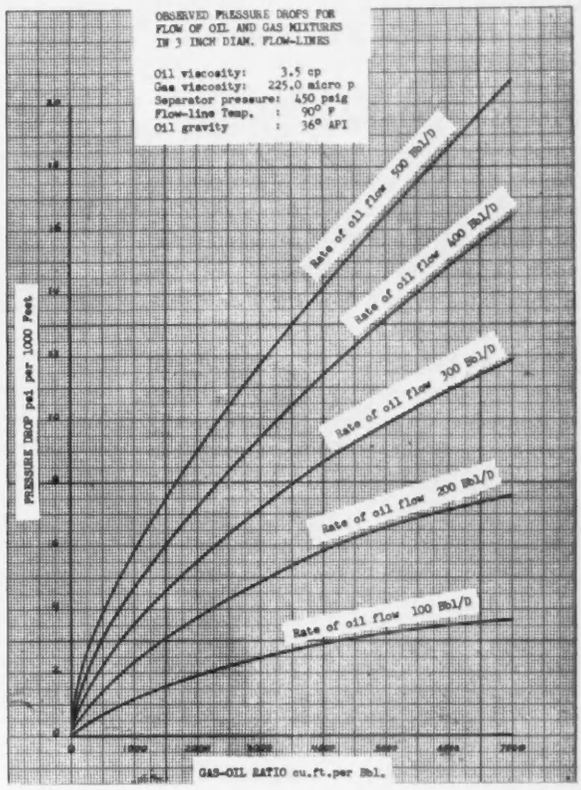

OBSERVED PRESSURE DROPS FOR
FLOW OF OIL AND GAS MIXTURES
IN 3 INCH DIAM. FLOW-LINES
Oil viscosity: 3.5 cp
Gas viscosity: 225.0 micro p
Separator pressure: 450 psig
Flow-line Temp. : 90° F
Oil gravity : 36° API
Rate of oil flow 500 Bbl/D
Rate of oil flow 400 Bbl/D
Rate of oil flow 300 Bbl/D
Rate of oil flow 200 Bbl/D
Rate of oil flow 100 Bbl/D
PRESSURE DROP psi per 1000 Feet
GAS-OIL RATIO cu.ft.per Bbl.

FIGURE 3

Pressure drop equation for turbulent flow of both liquid and gas (Reynolds numbers greater than 2000).

$$\left(\frac{\Delta P}{\Delta L}\right)_{T-P} = \left(\frac{\Delta P}{\Delta L}\right)_g \left[1 + a^{1/4}\left(\frac{\mu_l}{\mu_g}\right)^{0.083}\left(\frac{\gamma_g}{\gamma_l}\right)^{0.416}\left(\frac{W_l}{W_g}\right)^{0.15}\right]^{2.4}$$

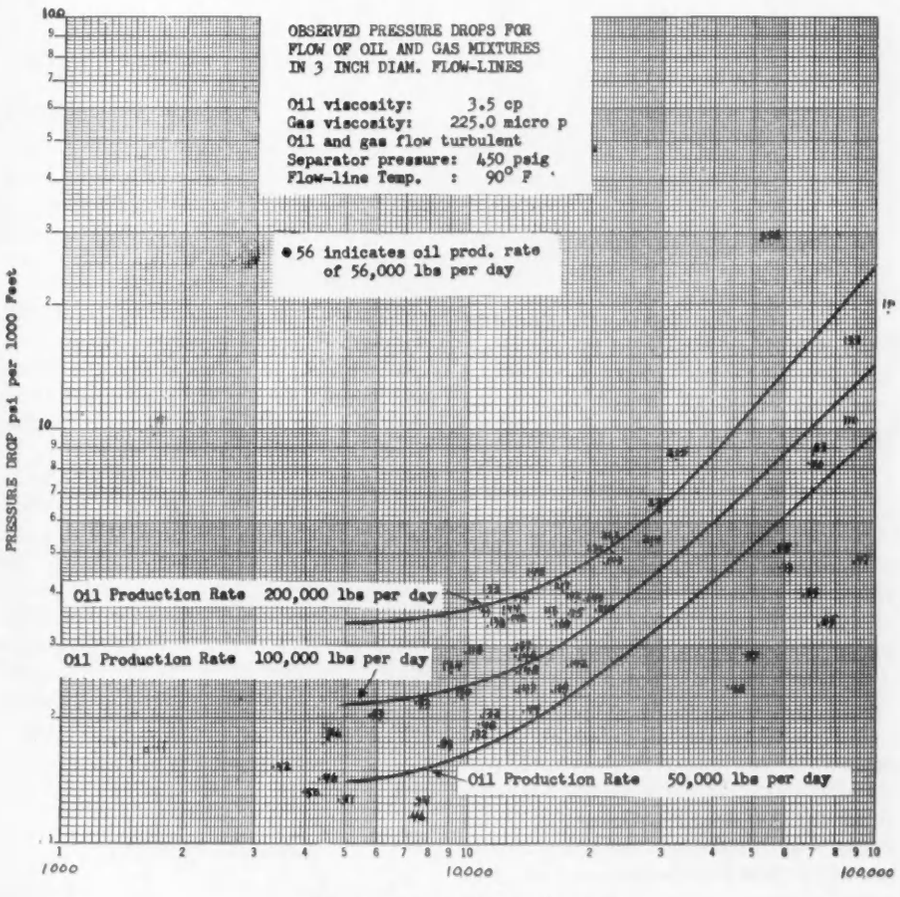

OBSERVED PRESSURE DROPS FOR
FLOW OF OIL AND GAS MIXTURES
IN 3 INCH DIAM. FLOW-LINES
Oil viscosity: 3.5 cp
Gas viscosity: 225.0 micro p
Oil and gas flow turbulent
Separator pressure: 450 psig
Flow-line Temp. : 90° F
• 56 indicates oil prod. rate
of 56,000 lbs per day
Oil Production Rate 200,000 lbs per day
Oil Production Rate 100,000 lbs per day
Oil Production Rate 50,000 lbs per day
PRESSURE DROP psi per 1000 Feet
GAS PRODUCTION RATE pounds per Day

FIGURE 2

where:

$\left(\frac{\Delta P}{\Delta L}\right)_{T-P}$ = Pressure drop per unit length for two-phase flow.

$\left(\frac{\Delta P}{\Delta L}\right)_g$ = Pressure drop per unit length due to gas flowing at a rate W_g with density γ_g in pipe of diameter D_g(lb. per sq. ft.) per ft.

a = Flow-type modulus for liquid, dimensionless. (See Fig. 10 of Reference [1])

μ_l = absolute viscosity of liquid lb. sec. per sq. ft.

μ_g = absolute viscosity of gas lb. sec. per sq. ft.

γ_l = weight density of liquid lb. per cu. ft.

γ_g = weight density of gas lb. per cu. ft.

W_l = Weight rate of liquid lb. per sec.

W_g = weight rate of gas lb. per sec.

Analytical Curves

The analytically derived pressure drops are presented graphically in Figure 1 together with empirical curves constructed on the basis of the experimental field data as shown in detail in Figure 2. Although Figure 2 indicates a considerable scattering of individual points, defi-

nite trends nevertheless are indicated which, as shown in figure 1, are in general agreement with the analytically derived data. It is to be noted in this regard that at the low rates of gas flow the empirically observed pressure drops are higher than those computed analytically but that such difference is less than 1 psi per thousand feet and hence insignificant from a practical standpoint. At the higher rates of gas flow the divergence is sufficiently great to warrant some consideration, but it is to be observed that here the divergence is in the direction of conservatism in that the analytically computed pressure drops are higher than those actually observed. Hence, flow lines designed on the basis of the theoretical concepts provide a corresponding margin of safety to handle overload conditions.

Charts Are Adaptable

Figure 3 presents observed pressure drops in a three-inch flow line for a 36 degrees API oil at various gas-oil ratios and at an average temperature of 90° F. in a form more readily adaptable to practical oil field use. It is evident that similar charts could easily be prepared for any other set of field conditions as to line size, gravity and temperature. It is to be noted that the availability of this type of information is of use in this form beyond the design stage as it affords a ready means of checking periodically the condition of the flow lines. Thus, should a gradual upward divergence of pressure drop become apparent it would be indicative of a decrease in the effective diameter of the flow line, as may occur due to a deposition of precipitates such as paraffins or bitumens. Early recognition of such a condition is desirable as corrective measures may then be resorted to before a complete plugging of the flow line occurs. Should complete plugging develop, it is evident that portions of the line will then be exposed to the full wellhead tubing pressure which in turn may cause pipe failure and hence expensive repair work.

☆

REFERENCES

[1] "Isothermal Pressure Drop for Two-Phase Two-Component Flow in a Horizontal Pipe" by Martinelli, Boelter, Taylor, Thomsen and Morrin. Trans. ASME Feb., 1944.

[2] "Two-Phase Two-Component Flow in the Viscous Region" by Martinelli, Putnam and Lockhart. Trans. AICE Aug. 25, 1946.

Notes on Corrosion

■ CONTINUED FROM PAGE 154

tendency of the several metals and alloys to set up galvanic corrosion. Actual corrosion cannot proceed unless there is a flow of electrical current. It is basically a question of amperes rather than volts. Just as in ordinary corrosion, the ease with which this current can flow and the magnitude of the current are controlled by a number of basic factors.

These factors are generally discussed under the headings: (1) Conductivity of the Circuit, (2) Potential between the Anode and the Cathode, (3) Polarization, (4) Relative Cathode and Anode Areas, (5) Geometrical Relationship between Dissimilar Metal Surfaces, and (6) Contact Between the Metals. Let us briefly summarize some of the more important practical rules that have been derived by corrosion engineers from a study of these factors.

To Minimize Galvanic Corrosion

1. Select combinations of metals as close together as possible in the Galvanic Series.

2. Avoid making combinations where the area of the less noble material is relatively small. It is good practice to use the more noble metals for fastenings or other small parts in equipment that is built largely of less resistant materials.

3. Insulate dissimilar metals wherever practical. If complete insulation cannot be achieved, anything such as a paint or plastic coating at joints will help to increase the resistances of the circuit.

4. Apply coatings with caution. For example, do not paint the less noble material without also coating the more noble, otherwise greatly accelerated attack may be concentrated at imperfections in coatings on the less noble metal. Keep such coatings in good repair.

5. In cases where the metals cannot be painted and are connected by a conductor external to the liquid, the electrical resistance of the liquid path may be increased by designing the equipment to keep the metals as far apart as possible.

6. If practical, add suitable chemical inhibitors to the corrosive solution.

7. If dissimilar materials well apart in the series must be used, avoid joining them by threaded connections, as the threads will probably deteriorate excessively. Brazed joints are preferred, using a brazing alloy more noble than at least one of the metals to be joined.

8. If possible, install relatively small replaceable sections of the less noble material at joints, and increase its thickness in such regions. For example, extra heavy wall nipples can often be used in piping, or replaceable pieces of the less noble material can be attached in the vicinity of the galvanic contact.

9. Install pieces of bare zinc, magnesium or steel so as to provide a counteracting effect that will suppress galvanic corrosion.

Some Practical Aspects of Galvanic Corrosion

Galvanic or bi-metallic corrosion, as it is sometimes called, has acquired an unduly bad name in many quarters. Some quite fantastic difficulties are attributed to it, and in some quarters galvanic effects are apparently held responsible for all failures not readily explained on other grounds. It is a fact that serious effects can often be traced to an unusually poor choice of dissimilar metals from points far apart in the galvanic series. But it should not be forgotten that in many cases and for many years judiciously selected by-metallic systems have given excellent service. For years ferrous valves have been trimmed with non-ferrous alloys, and non-ferrous fittings have been used with iron and steel pipe, with excellent results in many cases. When an occasional failure arises it is not uncommon to search for galvanic effects, and to overlook the fact that the less noble metal would have succumbed to the corrosive fluid being handled even if it were not coupled to its nobler partner.

It is often good practice to use fastenings or other vital parts made of more noble materials in equipment largely built of less noble materials for economic reasons. As an example, monel bolts are successfully used for holding together parts of iron or steel condensers exposed to sea or brackish cooling water. Also, monel bolts or rivets may be used on removable iron impellers in iron pumps handling corrosive solutions.

Nickel, monel and inconel are fairly close to each other in the galvanic series, and usually they can be used together in equipment without danger of significant damage. Practical experience has shown that metals and alloys within the nickel and copper groups have no great tendency toward mutual galvanic corrosion. Several of such materials may often be used together, except in cases where the area of a less noble material is considerably smaller than the area of the more noble material in contact with it. This is a generalized statement to which there may be exceptions. Broadly speaking, there is no getting around the desirability of having corrosion-resisting equipment built of a single material throughout.

☆

ACKNOWLEDGMENT

Figures 1, 2, 3, and 4 through the courtesy of R. J. Villagrana and W. W. Messick, "Economics of Oil Well Corrosion Control," API paper No. 801-25D.

THE DRILLING INDUSTRY'S BEST SELLING

CORE REEL

IT'S A Wilson OF COURSE!

because YOU GET *Wilson* PRECISION,
ADVANCED ENGINEERING AT LOWEST PRICE

With Waukesha MZAU Engine
$3,305.00
With Buda K-428 Engine
$3,336.00
Prices FOB Wichita Falls

The WILSON Core Reel has spooling capacity of 12,000 feet of 5/8" wire rope or 15,000 feet of 9/16" wire rope. Recommended for use in taking wire line cores on wells up to 15,000 feet in depth, and can be furnished with either gasoline, butane, or diesel engines, used in conjunction with a four-speed truck type transmission. With 8" wide, full wrap brake on a 36" diameter, the unit has ample braking capacity for any depth of coring.

Coring with this type unit has a definite advantage over a core reel mounted on the drawworks with the drawworks engines as power. With the Wilson Core Reel, it is not necessary to operate the large drilling engines or other drives for this light operation. In stock. Available for immediate delivery!

Wilson MANUFACTURING CO., Inc., Wichita Falls, Texas

Pacific Coast Distributor: Power Rig & Equipment Co., Los Angeles, California
Export Agents: Daniels, Beckley and Associates, 30 Rockefeller Plaza, New York City
Langley y Cia, Corrientes 1115, Buenos Aires, Argentina — TA-35, Libertad 9535.

Application and Efficiency of Gas-Lift

By CHARLES C. BANKHEAD, JR.
Dear-Bank Corporation, Long Beach, Calif.

THE use of high pressure gas generally represents the most inexpensive means of artificially producing a well when gas is available in a field. The capital cost of the equipment, both surface and subsurface, is about a standoff with conventional pumping at shallow depths, but the cost differential generally increases rapidly in favor of gas-lift with depth. Likewise, the efficiency is greater and the cost per barrel of the lift is less as depths increase than beam pumping.

In the early stages of the field, a line from a high pressure separator will make available sufficient energy to maintain production from the weak wells. Later, compressors will be necessary to circulate the gas, but the capital investment normally is lower than that of individual pumping units at each well. Fields having pressure maintenance projects are ideal for gas-lift as the basic compressor plant already is installed and additions to the plant can be made at nominal costs. However, to be successful, gas-lift must include proper downhole equipment combined with suitable surface installations.

THE AUTHOR details the operation of various types of down-the-hole gas-lift equipment, and classifies the application of each with regard to physical and productive characteristics of the well.

Types of Sub-Surface Equipment

There are a number of different types of gas-lift equipment and each, under certain conditions, is capable of doing a satisfactory job. These include:

1. The jet, which is a form of blowing gas around the bottom of the tubing string.
2. Ports or holes in the tubing.
3. The plunger lift.
4. Differential valves.
5. Pre-loaded valves designed to operate under surface regulation of pressure.
6. A combination of 4 and 5.
7. A wire line and bar designed to open mechanically a port into the tubing.
8. A dual chamber designed to permit formation fill-up at low pressure in a lower vessel while a load is being discharged by high pressure gas above.

All have certain disadvantages, mainly the necessity of pulling the well when the operating device requires servicing.

Sub-Surface Installations

A study of desirable features in gas-lift has indicated that a system should include the following:

1. The use of a packer combined with a back pressure valve on the bottom of the tubing string, on low volume wells, to keep the casing pressure off the formation.
2. A series of unloading valves designed to exclude passage of fluid (to minimize the possibility of cutting out the valves).
3. A means of permitting the fluid in the annulus to enter the tubing string at the bottom of the tubing, while not restricting fluid entry from the bore hole when the well is put on production.
4. A definite means of excluding the well's ability to produce while the unloading process is in progress (accomplished by means of a tubing plug or control valve which can be broken or opened when the well is unloaded and ready to be brought into production).
5. A removable piece of working equipment which can be recovered and repaired without pulling the tubing. This device should also rupture the tubing plug and seal the ports in the tubing. This latter requirement may only include the necessity of sealing the ports if the tubing seal is not needed (dependent upon available kickoff pressure and the productive index of the well). The salient features of a closed gas lift system embodying all of these features will be discussed below.

Differential Valves

The usual unloading medium is a differential valve, designed principally to pass gas. Figure 1 illustrates the valve assembly in normally closed position, with the bottom valve in contact with its seat and held there by the tension of the spring. Figure 2 illustrates the position of the valve closed by gas pressure in operation in the well.

Referring to Figure 1, the operation of the valve is as follows: Gas enters the valve through inlet port (1) from the casing, when the valve is assembled on the outside of a mandrel (to permit full clearance in the tubing string), and is confined in the dome of the valve above the seat. With the lower valve (5) held in contact against the lower seat (4) by tension of the spring, gas pressure through the seat is effective upon the upper face of valve (5), forcing the valve downward and off its seat (4), whenever the applied pressure exceeds the load of fluid in the tubing above any valve, plus ten pounds. This is the spring tension (8), holding the valve closed. This operation is termed the first opening.

As valve (5) is moved off its seat, gas passes downward through the seat into the lower zone of the valve above the piston (6). The movement of the valve stem downward lowers the piston (6) to uncover the outlet port (7). Approximately 40 percent of the gas entering the valve escapes through this port (7) into the tubing. The balance of the gas in the valve, at full applied pressure, acts upon the upper face of the piston (6), forcing the valve stem down. Against this applied pressure, the back pressure or pressure of the load in the tubing is effective on the lower face of the piston through port (9). Thus, the applied pressure acting upon the piston is offset in proportion to the differences in pressure, and as the escaping gas through (7)

lightens the load, this effect is transmitted through port (9) and the valve stem moves downward in the same manner as a regulator is controlled by its diaphragm. However, when valve (2), the upper valve, approaches close proximity to the top valve seat (3), it snaps into closed position, stopping passage of gas through the valve.

The operation described takes place at all valves during the automatic unloading of the well from valve to valve. All valves, after loading the fluid in the tubing above any valve in operation, maintain this position as long as pressure is applied to the casing. All valves below any valve in operation are in closed position as in Figure 1.

During unloading operations each valve operates to inject gas to lift the fluid above it, and then close. As fluid in the casing lowers and rises in the tubing, (U-Tube) the valve reopens due to the weight of the U-Tube fluid and continues to do this until the fluid level in the annulus falls below the next valve. Therefore, each valve may operate as many as three times, depending upon the size of the casing, before the next valve comes into operation. The unloading operation from valve to valve is entirely automatic without surface controlled devices. No fluid is forced through the valves; it is transferred into the tubing through the unloading chamber in the bottom of the well.

The reopening operation of the valve is the reverse of the operation described. Figure 2 represents any valve in the string, including the bottom one, or the removable drop valve. As the fluid rises above any valve to a height sufficient to create a pressure at the valve of 150 pounds less than the applied pressure, the valve opens. The fluid pressure in the tubing is effective back through Ports 7-9, exerting a pressure against the lower face of the valve (2). The spring tension plus the weight of the fluid, forces this valve upwardly and off its seat. Gas in the dome of the valve (applied pressure) being greater than the load, in an amount equal to the differential setting of the valve (150 pounds), immediately passes down through the seat, around the stem and closes the valve as described, whenever the load in the tubing has been lifted to the surface. Under no condition of pressure can fluid back-flow through the valve into the casing inasmuch as valve (5) is a built-in check valve. If at any time the pressure is insufficient to flow the well, this valve automatically closes, preventing reverse flow.

The description of the valve operation applies to both tubing or casing flow installations. The valves are interchangeable from tubing to casing flow as both types are attached to the mandrels

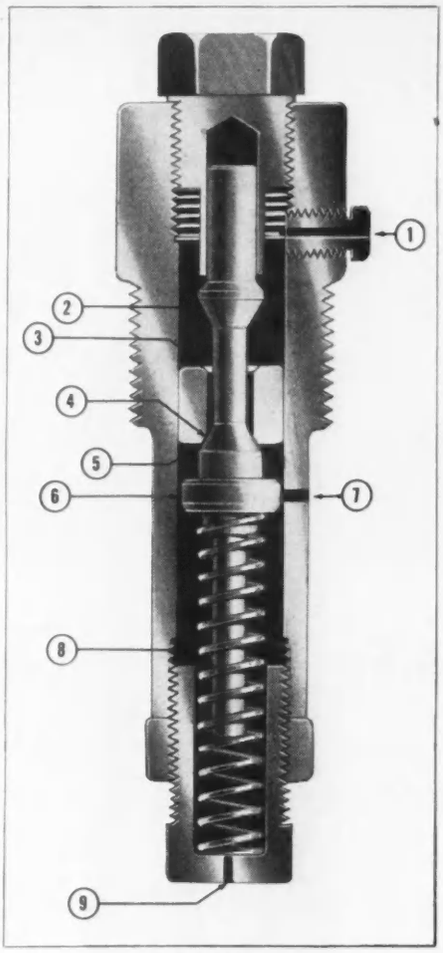


FIGURE 1

on the outside. The only difference between tubing flow valves and casing flow is the volume capacity of the valve. Control of volume in this type valve is of major importance. The volume capacity of a valve should be such that an efficient, not an excessive, starting speed is established by gas injection; otherwise, excessive friction losses are developed in fluid travel to the well's surface. Back pressures set up by these excesses defeat full expansion of the gas and thereby result in higher ratios.

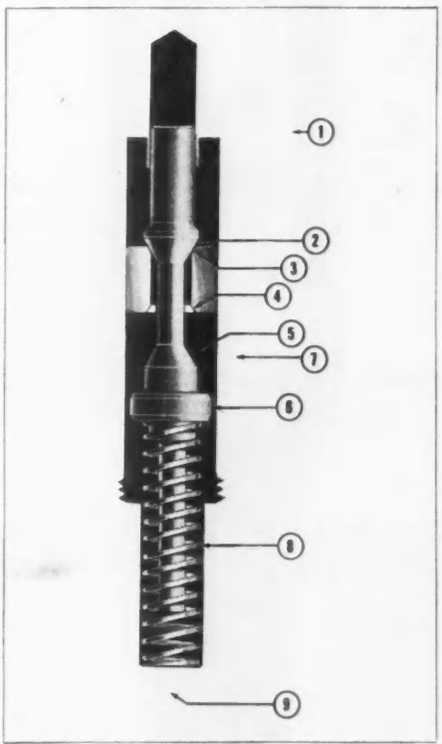


FIGURE 2

Pressure Loaded Valves

The design of this valve entails a bellows loaded at a predetermined pressure which will open a discharge port when the applied pressure exceeds this. Thus, the gas passes from the applied source through the port and under the load to be lifted. It will close when the applied pressure is bled down to the bellows loaded pressure. These valves normally have their best application on low volume wells. Valves which must unload the fluid through them require a large port size and must raise a maximum load each cycle to maintain efficient ratios. However, the problem of port size is not so difficult with the valve designed to pass only gas, as the starting velocity and rapid closing are the main considerations. The closed system employs the bellows valve in the drop valve to seal the ports in the receiving chamber when the well has been unloaded.

Often it is necessary for the drop valve to direct the gas downward into an accumulation chamber below the packer to discharge the load, as some wells have insufficient pressure to raise economically the fluid above the perforations.

Surface Installations

Successful gas-lift is dependent upon adequate surface devices to obtain maximum efficiency from the circulated gas. As the production from any well is the result of a lowering of the static bottom hole pressure, the surface problem is one of reducing the restriction to flow. Starting at the wellhead, these include:

1. Streamlined wellheads through the use of sweep ells or turns or dual flow arms without chokes or right angle turns.
2. Short flow lines of adequate size to handle the production without creating excess friction.
3. Low separator pressure with discharge ports on the trap of sufficient size to permit dumping into the tanks without building up pressure.
4. High pressure gas or compressor capacity of adequate size to give a margin of safety.
5. Reducing regulators installed on the injection line where constant casing pressure is required.
6. Time cycle intermitters in conjunction with reducing regulators are necessary when pressure operated valves are employed.
7. The injection gas should be as dry as possible.

8. Heaters are often advisable to reduce the possibility of freezing.

All of these aids help the field personnel and generally can be installed at a very low cost.

General Application

In general the types of wells fall into one of the following categories:

1. High bottom-hole pressure and high productive index. These wells are ideal for gas-lift and the amount of fluid that can be produced is limited only by the productive index and available gas pressure and volume. Where the quantities of fluid desired exceed the capacity of the tubing the system can be converted to casing flow, where the production is obtained from the annulus while the gas is injected into the tubing.

2. High bottom-hole pressure and low productive index. This type of well may be ideal for gas-lift dependent upon the depth and the formation gas-oil ratio. Normally high ratio wells at depths below 7500 feet make excellent prospects. The low gas-oil ratio formations generally result in intermitting flow with the production a function of the time required to expel each load and the rate of fill-up between cycles.

3. Low bottom-hole pressure and high productive index. In such wells the depth and necessary operating pressure become the most important factors. The operating pressure generally must be kept below the static bottom-hole pressure and in wells exceeding 5000 feet it often is necessary to sacrifice gross gas-fluid ratios to establish a flowing gradient sufficiently low to give the desired production. Intermittent operation is often advisable, where the casing pressure is always off the formation, if the time for each cycle still results in the desired production. It is obvious that the deeper the well the more difficult the problem.

4. Low bottom-hole pressure and low productive index. Wells in this category generally represent the end of productive life or ones where the decline curve has reached a minimum. They can be carried to depletion if gas is available in the field. It often is necessary to employ a fill-up chamber below the packer with a cross-over chamber at the drop valve. A small string of tubing extends from this latter chamber to the back-pressure valve on the bottom of accumulation chamber. Thus, when gas is admitted through the drop valve it passes into the lower annulus and forces the fluid up through the small tubing and thence to the surface.

Other Applications

Gas-lift is often a useful tool on specific well problems. It is an excellent means of completing a well to eliminate swabbing and permit early release of the expensive drilling rig. The system is run, the mud displaced with water, and the water gas-lifted until the well flows naturally. The later necessity to gas lift then can be accomplished without pulling the well as the equipment is already in place and requires only turning on the gas. If necessary, the well can be acidized through the tubing and the acid water gas-lifted out without danger of damaging the sub-surface equipment. Gas-lift is applicable for weak wells to increase production or to maintain flow on those tending to load up periodically as the differential valves operate only when the gradient becomes heavy enough for them to open. It also has proved to be a form of secondary recovery where it is necessary to produce large volumes of water to permit entry of oil into the well bore. Numerous wells must be produced at rates exceeding 2000 barrels per day to yield oil and the maximum production obtainable is merely a function of facilities and the well's capacity to produce.

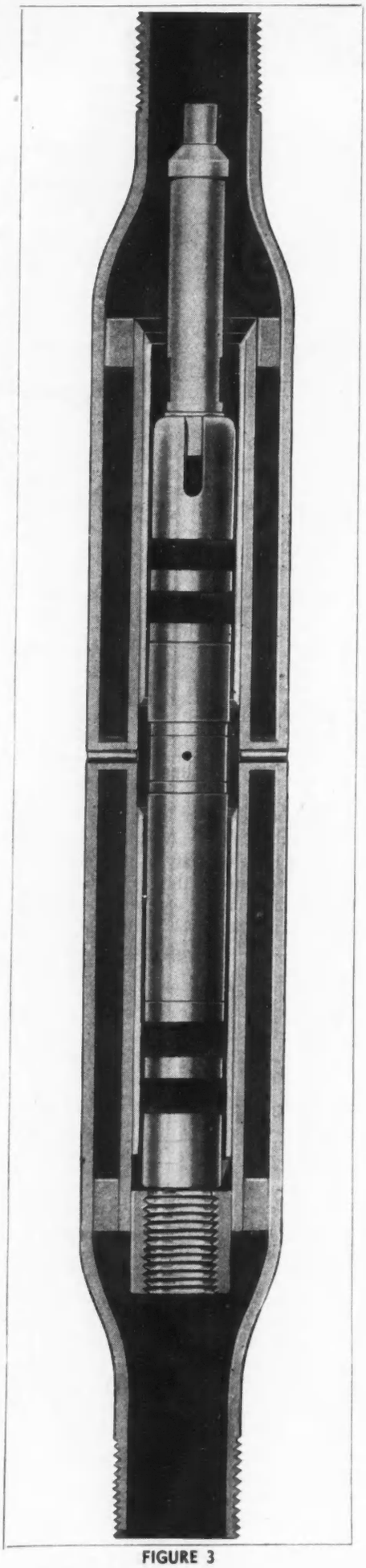


FIGURE 3

Proper Installation for Efficiency

Present installations of gas-lift equipment have resulted in efficiencies ranging from 30 percent to as high as 90 percent. This has been computed from determining the theoretical foot pounds necessary to raise a barrel of fluid from a given depth as compared to the actual energy required. In the calculations, the formation gas was considered as also being compressed; thus, the high volume, low ratio wells generally showed the best efficiencies. However, it is not possible to achieve efficient results unless the sub-surface equipment is properly installed to fit the available surface facilities. Consequently, complete well data are desirable before making an installation. The basic information should include:

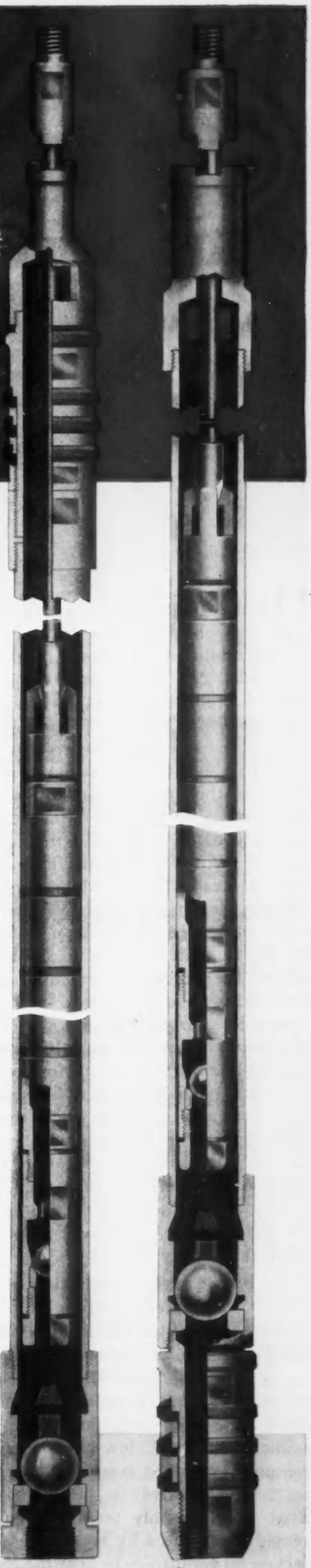
1. Static bottom-hole pressure and the productive index.
2. Well production history.
3. The available gas pressure and volume.
4. The back-pressure to be imposed on the surface flow line.

Based on the foregoing the installation can be designed to achieve the desired production. If controlled rates are desired, a bottom-hole choke can be combined with the drop valve or, if set for a maximum at early life, the rates can be controlled by limiting the daily hours on production.

Future

The future of gas-lift hinges upon the co-operation between field personnel, sales and service engineers and manufacturers. Good equipment properly installed to suit individual well's needs should result in economic well performance.

Pay off faster with oilmaster PETROL "A"



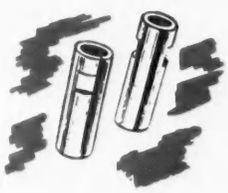
"A Superb Pump in a Quality Line"

—a broad statement, but let's analyze it. According to Mr. Webster, "superb" means "supremely good of its kind," and OILMASTER stands for quality in oil well pumps.

What other small bore pump offers these three outstanding features:

1 Hardened and honed, one-piece alloy steel barrel. (64 to 70 Rockwell C).

2 Heavy duty, one-piece pin-both-end chrome plated grooved plunger.



3 Heat treated API cages and fittings (all assemblies are equipped with API seats and balls).

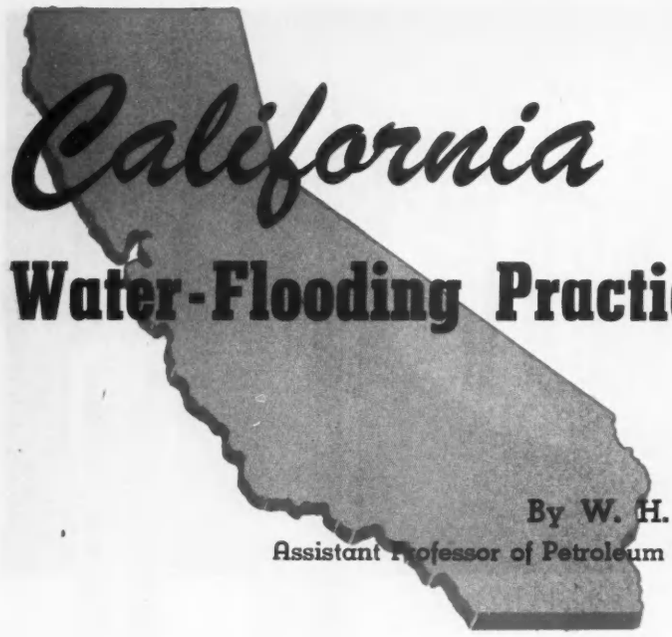
The Oilmaster Petrol "A" performs equally well in shallow "stripper" wells, or in deep wells of small volume.

FLUID PACKED PUMP COMPANY • LOS NIETOS, CALIFORNIA

EPPG OILMASTER PRODUCTS

DISTRIBUTED BY THE NATIONAL SUPPLY CO. EXPORT: THE NATIONAL SUPPLY EXPORT CORPORATION., 30 ROCKEFELLER PLAZA, NEW YORK

CO-DISTRIBUTORS: BERRY SUPPLY STORE, BEACON SUPPLY CO., INDUSTRIAL SUPPLY CO.



California Water-Flooding Practice and Research

By W. H. SOMERTON
Assistant Professor of Petroleum Engineering, University of California

OPERATORS in California have lagged far behind those in other areas in the adoption of secondary recovery methods. Yet California's tremendous rate of production is rapidly depleting oil reserves which are not being replaced by new discoveries. If this condition persists, it will become necessary either to increase the importation of oil from other areas or to resort to secondary recovery methods to meet the demand for oil. Various estimates have placed the reserves of "unavailable oil" in California's depleted or near-depleted oil fields as between 20.5 billion (estimated by U. S. Bureau of Mines) and 26.6 billion[1] barrels, or nearly four times the total cumulative production of the state over a long productive history. This oil is unavailable only in that it cannot be profitably recovered by primary methods, yet a portion of it may be recovered by secondary methods. (A more complete report [2 a,b,c] has been prepared surveying the possible application of the water-flooding method of secondary recovery to California oil fields. Most of the following information was obtained from this earlier report.)

Problems In Application of Water-Flooding

The hesitancy of California operators to adopt secondary recovery methods is partly understandable. The petroleum industry has been founded on and has thrived on high-risk, high-profit economics, whereas low-risk, low-profit ventures, such as secondary recovery, are less attractive to most operators. That this trend is possibly being reversed is indicated by the willingness of certain oil companies to bear the expense of developing and producing proven foreign areas with a very small margin of return.

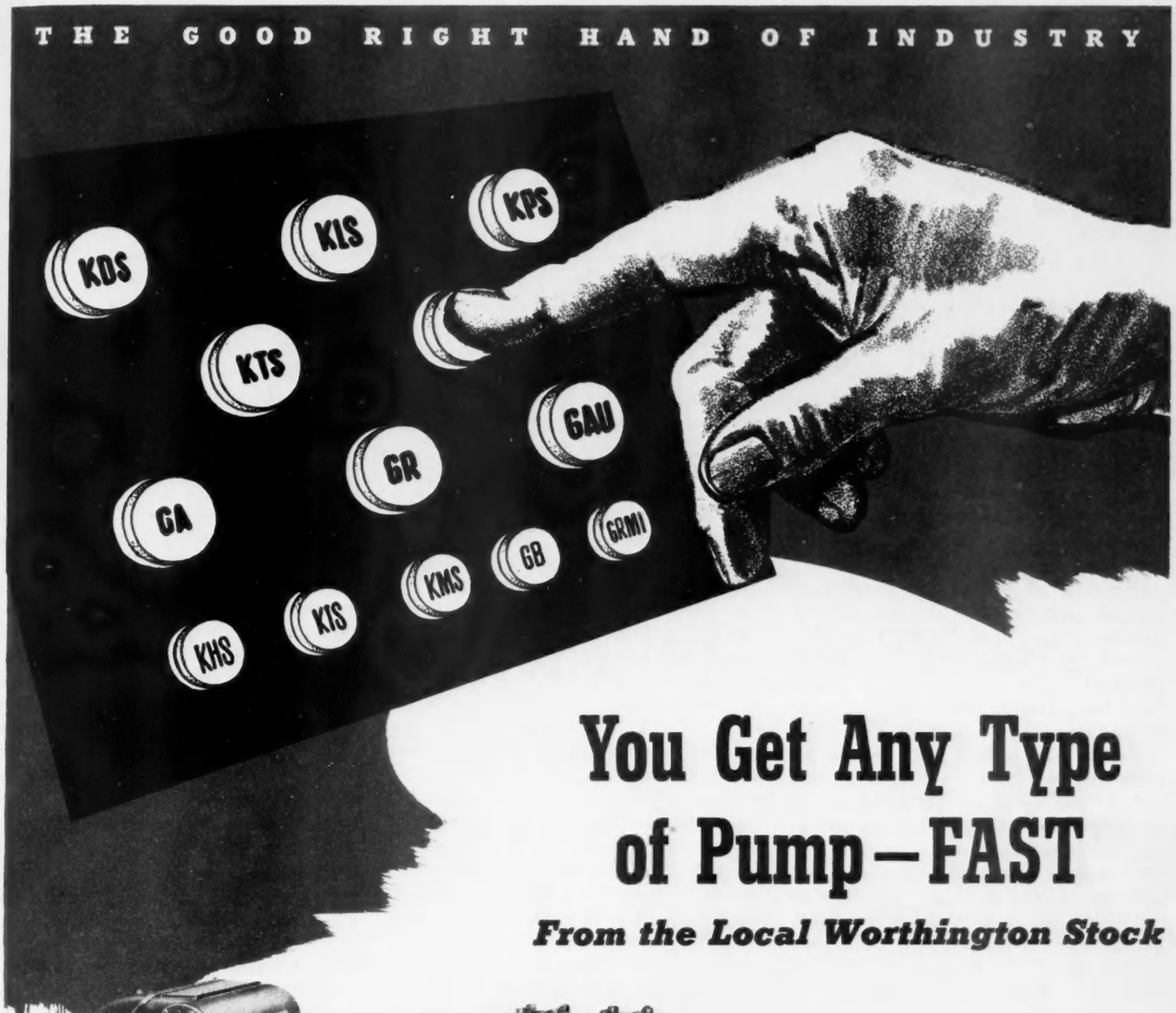
There are many problems of a physical nature which have delayed the application of secondary recovery. California oil reservoir conditions, when compared with those generally considered ideal for secondary recovery, do not appear to be favorable. Foremost among these physical problems are irregular, often steeply dipping structures intersected and displaced by numerous faults; productive formations consisting of thick, lenticular, interbedded shales and argillaceous sands and sandstones; highly variable physical properties of the reservoir rocks; low gravity and high viscosity crude oils. These conditions are admittedly unfavorable for the application of existing secondary recovery practices, but secondary recovery cannot be precluded on this basis when consideration is given to the large quantities of primary oil recovered under these same adverse conditions. California operators may not find it possible to profit directly from past water-flooding experience in other areas and modifications must be developed through laboratory and field research to cope with these problems.

Legal difficulties may present equally formidable problems. Townlot drilling and diversified land ownership are characteristic of many California fields and will increase the inherent difficulties of unitization. Although water-flooding has been successfully applied in other areas without unitization, unit control over a pool or portion of a pool within the field would be desirable. The alternative of small-scale, non-unitized projects would not only be less profitable but would increase the possibilities of legal attack by unsympathetic neighboring interests. All parties concerned should be educated in the benefits of secondary recovery. A sound argument based on laboratory and field research and analysis must then be presented before the necessary cooperation will be obtained.

The limited state legislation which might assist the operator in instituting secondary recovery operations in Section 3301 of the Public Resources Code, relative to the formulation of agreements for cooperative development. This section of the code states that in the interests of preventing unreasonable waste of oil and gas, the parties concerned may enter into agreements for cooperative development and operation, including production control and gas injection. Such an agreement once entered binds successors and assigns and is enforceable by law. Although this type of legislation is a step in the right direction, more rigorous laws are needed to compel cooperation in secondary recovery operations when it can be demonstrated that such action is essential to the public welfare. The Division of Oil and Gas will exercise a degree of control over water-flooding operations in a somewhat different direction. This division has complete jurisdiction and control of oil field waters and must witness and approve every water shut-off test. Because of this jurisdiction it will be necessary for the supervisor of the division to consider carefully and pass on each proposal for the purposeful injection of water into oil-producing formations. To carry out this new and important assignment, the engineering staff and facilities of the division must be greatly expanded.

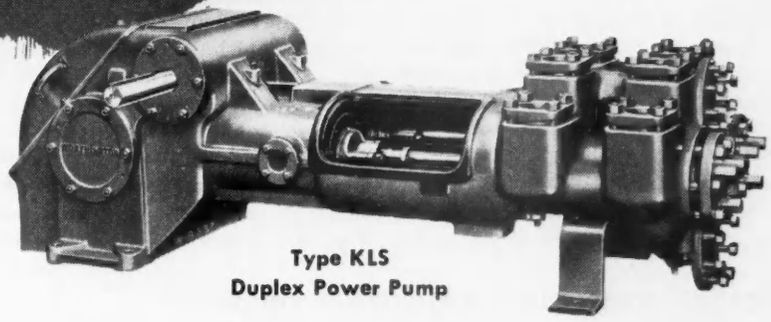
Of these many difficulties which have restricted the application of water-flooding in California, only the physical problems will be considered in this paper.

THE GOOD RIGHT HAND OF INDUSTRY



You Get Any Type of Pump—FAST

From the Local Worthington Stock



Type KLS
Duplex Power Pump

You need a pump—*fast*. You get your *pump*—any type of pump—*fast* by getting in touch with your Worthington dealer, who is as close as your phone.

There's a Worthington dealer at every oil center, and he has large stocks of all types of pumps and repair parts. His stocks are backed up by *complete* warehouse stocks at Tulsa, Houston, New Orleans, Los Angeles and San Francisco.

Remember—there's a Worthington pump for every pumping job . . . rotary, power, centrifugal . . . in a complete range of sizes. For example—

KTS 12-in. horizontal duplex power pump in bores from 3½ to 7½ in. (by half-inches).

KDS 4-in. horizontal duplex power pump in bores from 2½ to 4 in. (by half-inches).

So remember—Worthington is *everywhere* . . . Worthington supplies *every* type of *pump*. Rely on your Worthington dealer for your rush requirements.

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION
PUMP AND COMPRESSOR MERCHANDISING DIVISION
HARRISON, NEW JERSEY

The Good Right Hand of Industry

POWER TRANSMISSION: sheaves, V-belts, variable speed drives
PUMPS: centrifugal, power, rotary, steam
AIR COMPRESSORS: water-cooled, air-cooled

PCS922

Secondary recovery is not new to California. Van Wingen and Johnston[3] have reported 28 past and current secondary recovery or gas or oil storage projects in California fields. Nine of these are still in operation and, in addition, there are eight active primary pressure control projects.

Water-flooding attempts have been very limited. The most notable of these is the experimental project currently in progress in the Chapman zone of the Richfield field. Injection of water into a thin sand body within this zone was commenced March 29, 1944, in an attempt to determine whether the predicted low ultimate recovery from the zone might be increased. The zone selected for injection is encountered at about 3500 feet. It is described as consisting of medium grain size, friable, poorly sorted, generally argillaceous sand with an average porosity of 29.1 percent, permeability to air of about 422 millidarcys, and interstitial water content of approximately 37 percent.[4] The gravity of the oil is 19° API and the viscosity at reservoir conditions is approximately 50 centipoises. The water used for injection, which is that produced from the two productive zones in the field, has a total salt content of somewhat less than 11,000 ppm. By the end of 1947, a total of 326,900 barrels of water had been injected into the formation through the one injection well at a rate of about 300 barrels per day and pressure of 700 psi.[5] Four wells, one as far as 900 feet from the injection well, had been affected by the flooding operations. The total daily oil production rate from these four wells increased from 58 barrels per day at the time the project was first initiated to 198 barrels per day during December 1947. During the same period, water production decreased from 233 to 198 barrels per day. This does not include one producing well abandoned earlier when the water cut increased to 94 percent. Although it is not possible to judge the financial success of this project, the work has demonstrated that water can be injected into the reservoir at a sustained rate and that this water is capable of displacing considerable oil therefrom. The project has not only been continued but will be increased in scope.

The injection of water through a well in the Stevens zone of the Greeley field was commenced February 8, 1944, as a means of overcoming a serious waste-water disposal problem. A second injection well was put into operation about a year later to permit complete disposal of all waste water from the field. The depth of the Stevens producing zone is about 7700 feet and the thickness about 100 feet. The producing sands are lenticular, lensing into shale beds, and have been described as "firm, friable, medium to coarse grained with grit grains and a few thin streaks of sandy, micaceous, dark gray shale."[6] The porosity averages 21 percent, the permeability to air 180 md. and the interstitial water content 34 percent. The oil produced from the zone has a gravity of 32-36 API and a viscosity of about three centipoises at 100° F. The water produced from the Stevens zone has a total salt content of about 21,000 parts per million and receives but a minimum of treatment before injection. It has been possible to inject 2400 barrels of water a day at a pressure of 2500 pounds per square inch and to maintain this rate without increasing the pressure. In addition to providing a means of disposal of waste water, increased oil production has been noted in adjacent wells. The production from one well increased from a normal average of 150 barrels per day to more than 300 barrels per day. This would indicate that primary pressure control by water injection is practical, although the project has been of too short duration to draw definite conclusions.

Other water-flooding attempts in California have not been as successful as the two discussed above. For example, water injection was attempted through an unproductive edge well in the south end of the Lost Hills field without obtaining any beneficial results. The failure was believed due to the injected water invading a zone other than that anticipated. This was an interesting attempt, however, in that the source of water was a deeper zone in which pressure was sufficiently high so that the water could be directly injected through a closed system without pumping.

In addition to this experimental work, a water-flooding project is in progress in the Dominguez field. A second project is in the planning stage in the Edna field with operations soon to get under way. Although little information has been released on these projects, it is encouraging to note that large scale operations are planned and it will be interesting to follow their progress.

There are many problems of a physical nature with which the water-flooding operator in California will have to deal. Some of these problems may be deduced at the present time; others will arise as field developments are expanded. It is difficult to judge the relative magnitude of these problems, but at the present time the following topics appear to be of importance.

Geological Conditions

California fields are, for the most part, comparatively small in areal extent with thick interbedded producing formations. These formations are generally moderate to steeply dipping and are commonly intersected and displaced by numerous faults. As to depth, the older fields and zones should be classified as from shallow to moderate. The newer fields and zones are moderate to deep.

These conditions give rise to many problems. The great thicknesses of producing formations will lead to difficulty in controlling the movement of the injected water. The interbedding of

GENERAL CHARACTERISTICS OF SOME OLDER CALIFORNIA OIL FIELDS

FIELD	Structure[1]	Dips	Age	Type[2]	Consolidation	Porosity	Permeability	Water Sat. Percent	Encroachment	Gravity °A.P.I.	Viscosity cp. 100 °F.
Belridge, N.	A-F	Mod.	Mio.	S	Firm	12-20	.....	35	Slow	14-36	.....
Buena Vista Hills	A-L-F	15°-25°	Plio.	S	Poor	27	210	....	Negl.	25	.....
			Mio.	S	Firm	21-30	230	30	Slow	31	.....
Coalinga, E.	A-B	Mod.	Mio.	S	Poor	21-30	680	65	Slow	21	35
Coalinga, W.	M-U	Mod.	Mio.	S	Poor	20-46	200-4500	65	Slow	17	257
Coyote, W.	D-F	Mod.	Plio.	S	Fair	22	150-410	35	Slow	19-32	13-up
			Mio.	S	Firm	20	Low	.....	Slow	30	.....
Dominguez	A-F	15°-20°	Plio.	S	Fair	25-29	100-150	37-41	Mod.	29-33	5.5
			Plio.	S	Firm	20-24	40-100	32-50	Mod.	30	.....
Huntington Beach	M-A-F	Low-Mod.	Plio.	S	Poor	26-28	900	35	Slow	16-24	25.5-up
			Mio.	S	Poor	25	.....	40	Slow	24	.....
Inglewood	D-F	To 30°	Plio.	S	Poor	29	.....	.....	Active	20-30	4-29
			Mio.	S	Firm	17	.....	45	Active	17-32	5-up
Long Beach	A-F	10-45°	Plio.	S	Poor	30	.....	.....	Slow	22	27
			Mio.	S	Well	22	.....	.....	Mod.	25-29	.....
McKittrick	M-U	15-20°	Plio.	S	Poor	38	.....	25	Slow	14	.....
Montebello	A-F-L	Mod.	Plio.	S	Poor	27	400	.....	Slow	20-35	.....
			Mio.	S	Fair	20-27	.....	.....	Slow	36	3.6
Richfield	D-F	To 25°	Mio.	S	Firm	20-35	100-1300	37	Slow	19-22	71
Santa Fe Springs	D	Low	Plio.	S	Poor	29	945	21	Sl-Act.	26-34	.....
			Mio.	S	Well	22	.....	.....	Rapid	34	3.8
South Mt.	D-F	12-60°	Olig.	S	Poor-Well	14-20	35-350	.....	Negl.	24	.....

[1] A—anticline; B—bituminous seal; D—dome; F—fault; L—lithologic; M—monocline; —-unconformity.
[2] Sand or sandstone.

THE BEAVER HAS A PADDLE-SHAPED TAIL

Why?

** Designed for a Specific Purpose*

Beavers are natural engineers. They methodically build their homes in the water, using trees they cut down on the bank's edge. The heavy timbers must be hauled into place. So nature gave the Beaver a flattened, paddle-shaped tail . . . a natural "sculling oar and rudder" making it an excellent swimmer.

THE CSCO PUMPING ENGINE

. . . Designed for a Specific Purpose

TO PUMP OIL!

For years the oil producing industry was in need of a pumping engine designed for the specific purpose of pumping oil. Until four years ago operators had to be content with engines adapted from those originally designed for other uses. Then, to satisfy this long felt need, Continental introduced the CSCO line of pumping engines.

Every day since the first CSCO went into service, more and more CSCO's have been put to work . . . operating 24 hours a day, month in and month out, under every possible condition.

No other one engine has these important features: *Enclosed* to conquer dirt . . . *Pressure lubricated* to conquer wear . . . *Steam cooled* to conquer heat and cold . . . *Heavy flywheel* to conquer peak load.

Ask a Continental Man for complete details

CONTINENTAL

SERVING THE OIL AND GAS INDUSTRIES

THE CONTINENTAL SUPPLY COMPANY, *General Offices:* DALLAS, TEXAS

Export Division: 30 Rockefeller Plaza, New York, N. Y.

Representatives: ARGENTINA • BOLIVIA • BRAZIL • CHILE • CHINA • COLOMBIA • ENGLAND • ECUADOR • PERU • TRINIDAD • URUGUAY • VENEZ

oil sands, wet sands and non-productive sandy shales and shales may give rise to serious bypassing unless suitable preventive measures are taken. In cases where the interbedding displays a lateral continuity, the application of selective plugging and selective injection methods should overcome this difficulty. Where this continuity is lacking, as is quite common in California, the problem remains of imposing importance and is a major research problem.

The moderate to steeply dipping nature of the formations will restrict the application of intensive blanket flooding. The effects of gravity segregation will become important in all cases and up-dip flooding may have to be employed. This does not appear to be an unfavorable situation for gravity segregation and, if properly utilized, should be beneficial to the flooding process. The fact that these formations are frequently intersected and displaced by faults is quite another matter. The role the faulting system plays in the flow of fluids through the formation must be thoroughly understood. If the faulting is such as to divide the formations into isolated fault blocks and if these blocks can be clearly defined, the problem is unimportant, for each block may be handled as a separate flooding project. In any case, considerable sub-surface information will be required to define clearly the effects the faulting will have on injection.

The principal significance of depth of the producing zone is the cost of drilling new wells and of reconditioning existing wells for the flooding program. In many fields it is difficult to estimate an average depth of producing zones because of the high dips of the beds. However, a recent survey[2b] showed that nearly one-third of the productive zones in California oil fields are 2000 feet or less in depth and that over two-thirds of the zones are less than 5000 feet deep. In most cases the shallower zones are the older zones which are reaching primary exhaustion and which therefore are of the greatest interest to the secondary recovery operator. Development costs for these shallower zones should not be prohibitive. In the deeper zones where drilling costs will be higher, consideration should be given to wider well spacing and to the maximum use of existing wells. Another consideration in the matter of development costs is the fact that in many cases exploratory wells will be needed to obtain sufficient sub-surface information to formulate the flooding program. These exploratory wells can be completed as producing or injection wells, as the need may be, thus serving a dual purpose. It appears that depth is not an important limiting factor in the application of water-flooding to California oil fields.

California producing formations are for the most part sands and sandstones, although productive fractured shales and cherts are becoming increasingly more common. Although the sand-type reservoirs vary widely from one area to another and according to their geologic ages, they are generally arkosic with characteristic poor sorting as to grain size and mineral type. Cementation is limited or entirely lacking, giving rise to the comparatively high porosities commonly found. Although few analyses have been made, the reactive clay content of these formations is believed to be rather high. This has been substantiated by the comparison of air, fresh water, and salt water permeabilities of core specimens[7] and by the comparison of well completions using oil-base and water-base drilling fluids.

Pliocene and Miocene Sediments

At this point a distinction should be made between Pliocene and Miocene sediments. Pliocene sands are generally unconsolidated to poorly consolidated and display high porosity and moderate to high permeability. Miocene sands range from unconsolidated to well consolidated, occasionally cemented with carbonates. The porosity of these latter formations ranges from high to moderate and the permeability from moderate to low. In both cases, these properties are highly variable over short distances both laterally and vertically. Information is not available as to the pore shape, size, and size distribution of California reservoir sands. It may be inferred, however, from capillary-pressure—saturation curves for California sands that there is a wide distribution of pore sizes.

Unpublished data[8] indicate that the mineral content of a normal reservoir sand has, in itself, little bearing on the displacement phenomena and recovery efficiency. The presence of reactive clay has a very important effect from several standpoints. The swelling capacity of a clay, and consequently the reduction of permeability of the sand containing clay, depends not only upon the type of clay, but also upon the nature of the water with which it is in contact. Thus it is important in maintaining injectivity to know the amount and type of clay present and to select a flooding water which will reduce clay swelling to a minimum. In this connection, the question may arise: if the reactive clay content of the reservoir sand is high, why do so many California fields have active edgewater drives? A possible answer may be that a clay is generally permeable to water which has the same characteristics as the water with which it is saturated. For example, a sodium-base clay is permeable only to aqueous sodium solutions. It appears likely that, through base exchange, clays present in oil sands will take on a base compatible with the water passing through the sands. It is also probable that the high salt content of the interstitial water maintains the clay in a flocculated condition permitting ready passage of formation water. To minimize clay swelling, it would appear desirable to employ for injection purposes saline water of a nature similar to that which is produced from the formation.

Clays in reservoir sands may also alter saturation-relative permeability relations. Many clays are capable of taking within themselves large quantities of water and thus effectively removing that portion of water from the fluid phase of the system. A high water saturation in such case would not necessarily denote a high relative permeability to water, or conversely, a low relative permeability to oil.

A thorough study of the influence of clays on water-flooding would be highly desirable. California reservoir sands should be carefully sampled and analyzed for clay content and clay type. With this information at hand the type and treatment of injection water to give minimum clay swelling could be determined.

Variable permeability of a reservoir sand is a difficult problem with which to contend. The first difficulty lies in the fact that it is impossible to determine with any degree of accuracy the permeability variations throughout a producing formation. Vertical variations in permeability can probably be accounted for by selective plugging, selective shooting, and selective injection if lateral continuity exists. If lateral permeability varies uniformly in one direction or another, it can be accounted for by the proper selection of injection and production wells and by the careful control of injection rates. When the above two conditions are not fulfilled, as is unfortunately characteristic of California producing formations, the problem becomes more complex. The fact that primary recovery has been profitable under these adverse conditions does not necessarily indicate that water-flooding would be successful. It is perhaps at this point that the benefits of gravity segregation by up-dip flooding may be realized. Considerable laboratory and field research will be required even to indicate the importance of highly variable permeability.

The shape, size, and size distribution of the pores of producing sands may have an important bearing on fluid flow and displacement phenomena. If the pore channels are flat and exceedingly thin as reported by Ryder[9] for Bradford

sand, the importance of surface forces becomes obvious. It is believed that this type of pore channel is not characteristic to California sands, although thin section and wax mold studies should be undertaken to clarify this latter contention.

Fluid Characteristics

The API gravity of California crude oil is generally lower than that produced in other areas. Gravity is an index of the feasibility of water-flooding in that the selling price and therefore the income from the project will be determined by the gravity of the oil produced. The favorable market for oil in California and the favorable price obtainable for all grades of oil make this factor of small importance. Gravity is important, however, in that it is an index of the other physical properties of the oil, notably viscosity. The viscosity of most California crudes when measured at surface conditions is high. Reservoir viscosity, on the other hand, is considerably lower than might be expected.

The viscosity of a crude oil alone is not as significant as the "mobility ratio." The "mobility ratio" is defined as the ratio of the mobility of the driving phase (water) to the mobility of the driven phase (oil), where the mobility of a phase is the ratio of the relative permeability of the phase to the viscosity of the phase.[10] Expressed mathematically this relation is:

$$MR = \frac{k_w \mu_o}{k_o \mu_w}$$

where:

MR = mobility ratio
k_w = relative permeability to water
k_o = relative permeability to oil
μ_o = viscosity of the oil
μ_w = viscosity of water

This ratio is a true index of the efficiency with which oil will be driven through the sand by the water. A high index would represent an unstable boundary condition in which water will readily bypass oil. A low index would indicate a stable oil-water interface and effective flooding.

In examining the above relation it can be seen that the terms in the denominator, k_o and μ_w, are essentially constant quantities which could hardly be altered. The work of Henderson and Yuster[11] indicates that in some cases the value of k_o can be increased by increasing the operating pressure. The terms in the numerator, k_w and μ_o, might be altered to give a lower mobility ratio. The use of high operating pressures would be effective in driving free gas into solution in the oil with resulting decreased oil viscosity. The one term, however, which might be altered sufficiently to give an appreciable reduction of the mobility ratio is k_w, the relative permeability to water. The fresh water permeability of California oil sands is known to be low. If this low water permeability is an attribute of clay swelling, it might prove desirable to employ an injection water which will promote a known and controlled amount of swelling. This is contrary to the normal procedure where an attempt is made to restrict clay swelling to a minimum, but it might prove an effective means of overcoming the disadvantages of high crude oil viscosity and thus decreasing the mobility ratio. Considerable research should be undertaken on this phase of the problem. Further studies should be made to determine the significance of the mobility ratio when the flow is an intimate mixture of "driven" and "driving" fluids.

Supply of Injection Water

Sources of injection water may be a major problem in water-flooding California oil fields. It is almost a certainty that fresh surface waters will not be available for injection purposes because of the lack of rainfall and the attendant water shortages in the state for the past several years. In addition, many of the fields are located in arid or semi-arid regions where water supplies have always been a problem. This indicates that sub-surface brines will have to be employed for injection purposes. Since many California fields are located in agricultural areas where water disposal problems are serious, the controlled reinjection of produced water may solve disposal problems and in addition produce a beneficial water-flooding effect.

Other sources of sub-surface water such as the Carneros formation of the Lost Hills field should be investigated. The possible use of ocean water in coastal areas should also be considered. This latter would provide an unlimited supply of water with constant characteristics and its saline nature may be such as to make it a very desirable injection water.

Water-Flooding Research

A moderate amount of water-flooding research has been undertaken by California oil companies and educational institutions during the last two decades. The work has been sporadic in nature and little has appeared in the published literature as to the results obtained. The last four years have seen greatly increased activity in this direction. The oil companies are becoming increasingly interested in secondary recovery and many are actively engaged in water-flooding research. With this renewed interest, it appears timely to discuss the problem of coordination of research activities.

The Interstate Oil Compact Commission has been conducting a vigorous campaign to promote and coordinate secondary recovery research. The aims of the Commission are outlined as follows:[12]

1. Encourage legislation permitting unitization of oil fields to permit the application of secondary recovery.
2. Collect and study production statistics and well records in all areas having secondary recovery possibilities.
3. Encourage research by states on methods of increasing oil recovery and periodic review of all important research in progress by educational institutions and industrial and research laboratories.
4. Maintain contact with all federal agencies having relations with the oil and gas industry.
5. Coordinate with other organizations interested in secondary recovery.

The commission emphasizes that it does not propose to engage in secondary recovery research but that it does propose solely to accumulate, coordinate, and distribute information, and lend its assistance and encouragement to states, educational institutions, and private companies in expanding their programs. In line with this policy, questionnaires were sent to many universities and colleges to determine the nature and extent of research in progress or contemplated, personnel, funds and facilities available, and other information of a similar nature. As California is not a participating member of the compact, direct benefits from this program may not be realized. Nevertheless, California operators and educational institutions will profit by the free interchange of information proposed by the Commission.

The Gaven Amendment of Public Law 443 (Synthetic Liquid Fuels Extension Act) passed by Congress March 15, 1948, authorized the U.S. Bureau of Mines to undertake a program of production research on secondary recovery from stripper oil fields. In addition to the important contribution the Bureau of Mines will make toward increasing the knowledge and application of secondary recovery, the passage of this act shows that the importance of such work has been recognized and this should give stimulus to other groups and to the industry as a whole.

In formulating the Bureau's program three general principles have been considered: (1) emphasis on those problems needing first attention in industry; (2) avoidance of unnecessary duplication of work being done by other research groups; (3) smoothing out of peaks and valleys of research activities.[14]

The program, which will cover all secondary recovery methods, is divided into three main types of problems: (1) fundamental research; (2) applied research on special engineering problems;

(3) engineering field studies. Fundamental research will be restricted primarily to a study of the nature of surface forces in petroleum reservoirs and their effects on displacement and flow through porous media. Applied research problems, some of which are under investigation at the present time, include: the use of explosives in well shooting; selective plugging of air-gas injection wells; fundamental studies of water chemistry, taking into account the effect of changes in pressure and contamination with connate water; flooding patterns; and many other problems which will arise as the program progresses. Engineering field studies will be made in each district to evaluate the success of existing secondary recovery projects and to study other fields as to their secondary recovery possibilities. Work done by the several districts will be carefully coordinated.

The Petroleum Field Office of the U.S. Bureau of Mines in San Francisco, under the direction of H. C. Miller, has recently begun its phase of the work. Dr. A. G. Loomis and several assistants have been retained to undertake the work in the California area. This group is now engaged in a comprehensive survey of the existing secondary recovery projects in California. After completion of this work, which will take several months, the group will begin a study of other California fields relative to their secondary recovery possibilities. Some laboratory work will be undertaken in conjunction with these surveys but laboratory research may be confined to problems unique to California conditions.

The Petroleum Field Office of the U.S. Bureau of Mines could play another very useful role in furthering secondary recovery in California by coordinating all field and laboratory research in progress throughout the state. Through such coordination, wasteful and costly duplication of effort would be avoided and much greater progress realized.

The educational institutions in California should become more interested in fundamental research relating to secondary recovery. Prospects that this will be the case are borne out by the recent appointment of Dr. S. T. Yuster to head petroleum engineering research at the University of California at Los Angeles. Although plans have not been formulated as yet, the appointment of such a noted expert on water-flooding as Dr. Yuster will have a far-reaching significance.

The Stanford University Research Institute has also recently announced the appointment to its staff of Dr. R. V. Hughes, formerly research director of the Penn Grade Crude Association. Although again final plans have not been announced, certain phases of water-flooding research are to be undertaken under the very capable direction of Dr. Hughes. One of the proposed problems will deal with the effects of clays in secondary recovery.

The University of Southern California has in progress a secondary recovery research program in which the emphasis is being placed on recovery from typical California oil sands. Closely associated with this work is a second project devoted to a study of the electrical resistivity of saturated and partially saturated oil sands.

A water-flooding research program is in progress at the University of California. This program was developed following a survey of California field conditions[2b,c] and includes problems discussed earlier in this paper. At the present time three topics are under investigation: mineralogical and physical classification of California oil sands; the clay content of California oil sands and its influence on water permeabilities; and further studies of the "mobility ratio" and how it is influenced by clay content.

The work on clay analysis is being done in cooperation with the Division of Ceramic Engineering. At present this work is sponsored and supported wholly by the Engineering Research Projects of the University and its progress is dependent upon the work of graduate students and part-time research assistants. It is hoped that the project will be expanded as additional support and facilities become available.

In addition to the above research, related work is being conducted by the Department of Geology and Geophysics at the University of California. A thin-section study of cementation is furnishing additional information on the nature of the pores of California oil sands. A second project in progress in this department, an investigation of the physical significance of the formation factor in electrical logging, is also an important phase of water-flooding research.

The Future

If California is to maintain its position as one of the leading oil producing states, operators must resort to secondary recovery methods. Although gas-injection methods might be used as an intermediate step, it appears that water-flooding must ultimately be employed in most cases to assure maximum recovery. There are two types of problems in the application of water-flooding: legal and physical. Proper and sufficient legislation must be enacted to protect the secondary recovery operator from unnecessary interference with his work. Physical problems are many and varied, but not insolvable. Considerable laboratory and field research will be necessary for their solution.

The most vital need of all is the coordination of effort of all those interested in the future of the industry in California. Fowler[13] makes the very pertinent statement that "research is always competitive to a certain degree, but fortunately in most cases it is a healthy stimulating variety that spurs each group on to find some new fact which others may use to mutual advantage." This must be borne foremost in mind in developing a coordinated program. A suggested means of accomplishing this end would be to delegate a government agency such as the U.S. Bureau of Mines or the California Division of Mines the task of coordination. Fundamental research would then be assigned to educational institutions and industry research organizations. Field and applied research might be taken care of by the Bureau of Mines and the oil companies. As the state of California receives a large portion of its revenues from the petroleum industry, costs of the research work should be borne equally by the State and the industry.

ACKNOWLEDGMENT

The author wishes to thank Dr. Olaf P. Jenkins, Chief, California Division of Mines, for permission to publish much of the material in this paper. Thanks are also due to the reviewers of this and the original paper for their suggestions and helpful criticisms.

BIBLIOGRAPHY

[1] Andrus, D. T., "Secondary recovery research." *Interstate Oil Compact Quarterly Bulletin*, Vol. V, No. 2, pp. 16-26 (August 1946).

[2] Somerton, W. H., "Water-flooding as a method of increasing California oil production," *California Journal of Mines and Geology*, (a) Part I, Factors influencing the application of water-flooding, Vol. 45, No. 2, (April 1949). (b) Part II, A survey of California conditions relative to the application of water-flooding. In press (July 1949). (c) Part III, Current and proposed water-flooding research in California. In press (October 1949).

[3] Van Wingen, N. and Johnston, N., "Current concepts of secondary recovery," *A.P.I. Drilling and Production Practice*, pp. 196-208 (1946).

[4] Babson, E. C., Sherborne, J. E., and Jones P. H., "An experimental water flood in a California oil field," *A.I.M.E. Trans.*, Vol. 160, pp. 25-33 (1945).

[5] Summary of Operations of California Oil Fields, Division of Oil and Gas, Vol. 33, No. 2, p. 44 (1947).

[6] Crooker, J. T., and Schnoor, F. H., "Wastewater injection in the Stevens zone—Greeley field," A.P.I. Division of Production Paper No. 801-22E (1946).

[7] Johnston, N., and Beeson, C. M., "Water permeability of reservoir sands," *A.I.M.E. Trans.*, Vol. 160, pp. 43-55 (1945).

[8] Eginton, L. G., "Influence of reservoir sand composition and characteristics on water-flooding efficiency," M. S. Thesis, Engineering Library, University of California, (1942).

[9] Ryder, H. M., "Character of pores in oil sand," *World Oil*, Vol. 127, No. 13 pp. 129-134 (April 1948).

[10] Dykstra, H. and Parsons, R. L., "The prediction of oil recovery by water flood," A.P.I. Division of Production Paper No. 801-24K (May 1948).

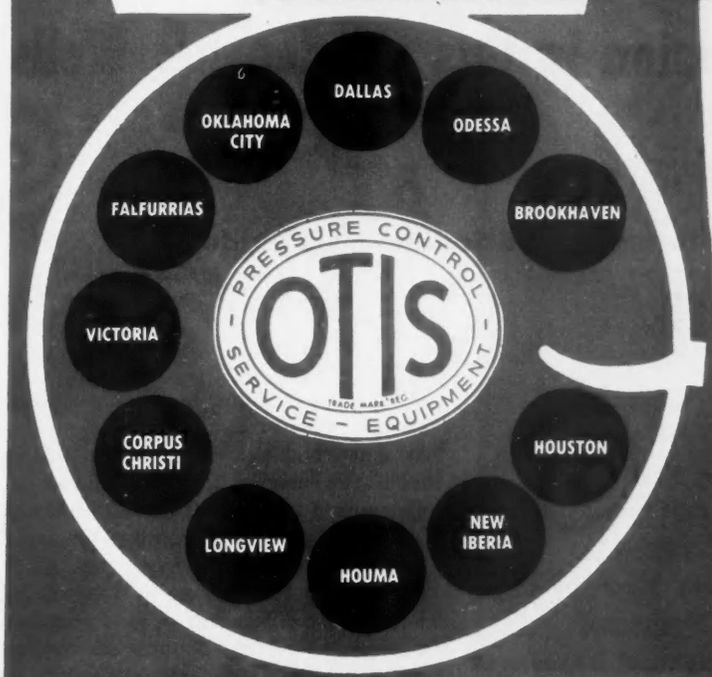
[11] Henderson, J. H., and Yuster, S. T., "Studies in relative permeability," *World Oil*, Vol. 127, No. 12, pp. 139-147 (March 1948).

[12] Foster, Earl, "Plans and purposes of Interstate Oil Compact Commission dealing with secondary recovery operations," *Oil and Gas Journal*, Vol. 46, No. 28, p. 286 (Nov. 15, 1947).

[13] Fowler, H. C., "Secondary recovery research and the Bureau of Mines," preprint of address given before the Interstate Oil Compact Commission meeting, May 7, 1948, Chicago, Illinois.

[14] U. S. Bureau of Mines, 1948 Annual Report, Part IV Secondary Recovery, "Synthetic Liquid Fuels," R.I. 4458, (January 1949).

when you call OTIS



you call the best in the oil patch for..

Running and Pulling OTIS SUB-SURFACE CONTROLS • TUBING CORROSION SURVEYS • PERFORATING AND CUTTING OFF TUBING • Running and Pulling TUBING and DRILL PIPE UNDER PRESSURE

When an Otis crew moves on your location, the entire Otis organization is standing by – ready if needed.

Should your well present an unusual high-pressure problem, Otis personnel is immediately available – with exclusive techniques gained from years of experience in the pressure control business and equipped with special tools and equipment produced through modern engineering, manufacturing facilities, and research.

If you need routine or emergency Wire Line Service, or tubing or drill pipe run or pulled under pressure—call the ONLY organization that can *follow through all the way* on an "under-pressure" job. Call the best in the oil patch. *Call* Otis!

PRESSURE CONTROL OTIS SERVICE - EQUIPMENT TRADE MARK REG.

OTIS PRESSURE CONTROLS, INC.

SERVICE

DISTRIBUTORS: **OTIS PESSSURE CONTROL, INC.**, DALLAS, TEX.; **OTIS EASTERN SERVICE, INC.**, BOLIVAR, N.Y.; **WESTERN PRESSURE CONTROL**, LOS ANGELES, CALIF.
FIELD OFFICES: **TEXAS:** HOUSTON, CORPUS CHRISTI, FALFURRIAS, VICTORIA, ODESSA, and LONGVIEW. **OKLA.:** OKLAHOMA CITY. **LA.:** NEW IBERIA and HOUMA. **MISS.:** BROOKHAVEN
EXPORT SALES AND SERVICES: **OTIS PRESSURE CONTROL EXPORT, INC.**, POST OFFICE BOX 7206, DALLAS, TEXAS, U. S. A.; CARACAS, SOUTH AMERICA
MANUFACTURE AND DEVELOPMENT: **OTIS ENGINEERING CORPORATION**, POST OFFICE BOX 7206, DALLAS, TEXAS, U. S. A.

Field and Laboratory Tests of

Sodium Chromates and Alkalies

for Controlling Corrosion in Gas Condensate Wells

Part 4

Tests of Mixtures of Sodium Chromate and Sodium Hydroxide

By

C. K. EILERTS
Principal Physical Chemist

R. V. SMITH
Physical Chemist

F. G. ARCHER
Laboratory Mechanic

L. M. BURMAN
Assistant Chemical Engineer

FAYE GREENE
Scientific Aide

H. C. HAMONTRE
Associate Petroleum Engineer

U. S. BUREAU OF MINES
BARTLESVILLE, OKLAHOMA

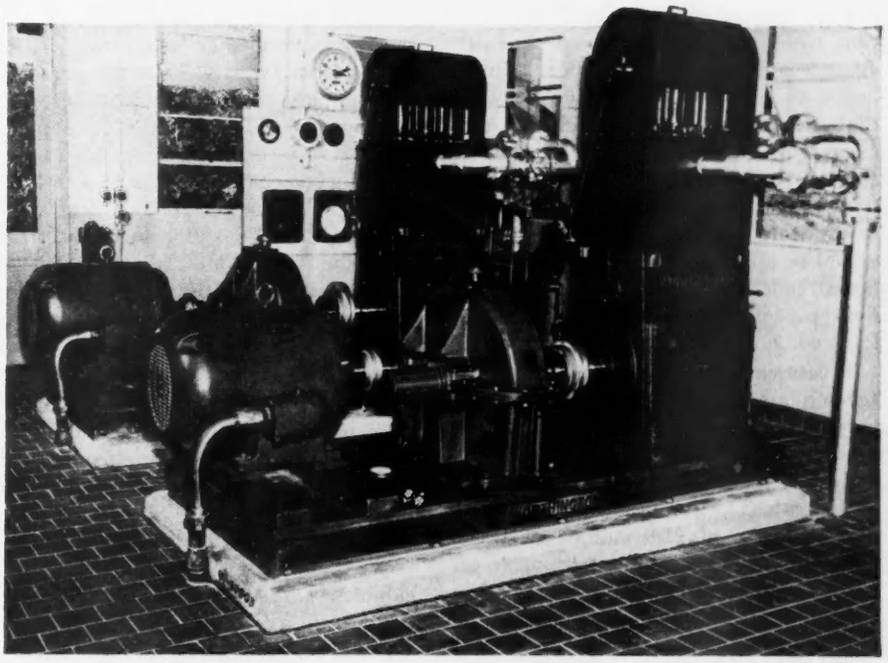
WHEN the tests using 10 pounds of sodium chromate per 100 gallons of treating solution were concluded on June 4, 1946, the rate of flow of gas through the tubing averaged 3.5 million cubic feet per day, and the tubing flow-capacity factor was 0.17. No attempt was made to wash deposited chromic oxide out of the tubing by means of water after the test was completed, because such obstruction in the lower part of the tubing string was favorable to the carrying out of subsequent tests. A cylindrical weight 1.75 inches in diameter lowered into the 2½-inch tubing had indicated that most of the deposit was within 100 feet of the tubing inlet. The resulting throttling of the gas in that section of the tubing would lower its temperature and tend to lower the levels at which water in different liquid:gas ratios would condense from the flowing fluid. Also, a reduction in rate of gas flow favored the conducting of tests suited to the limited pumping capacity then available for injecting water into the well at increased rates. The five tests that followed with solutions of sodium chromate and sodium hydroxide were intended to determine the effect of treatments with different amounts of sodium hydroxide to determine resultant variations in pH and its effects on control of chromate reduction. Just enough sodium chromate was injected to provide a slight excess in the effluent water.

The five tests beginning on June 4 and lasting nearly two months, were made with solutions of five pounds of sodium chromate (0.98 to 1.22 pounds per million cubic feet of gas) and varying quantities of sodium hydroxide in 100 gallons of water injected at the average rate of 22 gallons per million cubic feet of gas produced. This was one of the most successful series of tests from the standpoint of corrosion control. Iron in the effluent water averaged only four ppm, and the average rate of corrosion of wellhead coupons was less than 0.003 ipy. The rate of flow of gas from the well and the tubing flow-capacity factor were the same at the beginning and at the end of the tests although they varied up and down with the individual treatments. The pH of the effluent water ranged from 7.5 to 7.9 and the average total solids ranged from 4800 to 10,640 as the quantity of sodium hydroxide injected with the sodium chromate was increased from six to 18 pounds per 100 gallons of treating solution. A substantial part of the total solids was sodium bicarbonate which formed when the injected sodium hydroxide combined with carbon dioxide from the flowing gas. As shown in Columns 3 and 7 of Table 7, little was gained in pH by increasing the input of sodium hydroxide from nine to 18 pounds per 100 gallons of solution injected. The differences of nine pounds—equivalent to two pounds per million cubic feet of gas—was negligible as compared with the more than 1000 pounds that would have been required to convert all the carbon dioxide in a million cubic feet of the gas to sodium bicarbonate and thence to sodium carbonate of higher pH. It did not seem likely that any reasonable increase in the quantity of sodium hydroxide injected above 4.10 pounds per million cubic feet of flowing gas (Column 6, Table 7) would raise the pH of the flowing water significantly, and because of the difficulty experienced in handling and pumping the solution containing 18 pounds of alkali per 100 gallons of water, no more concentrated solutions were used.

Seven Weeks Protection

A finding of special importance coming from the results of the five treatments was that the injection of an average of 1.10 pounds of sodium chromate per million cubic feet of gas gave substantially complete corrosion protection for seven weeks without lowering the flow capacity of the tubing and that such a concentration provided an average of seven ppm of sodium chromate in the effluent water. It seemed evident that the use of a minimum quantity of

When the tankers can't deliver... these pumps can!



In the Socony Vacuum Pumping Station at South Portland, Maine . . . The Worthington Variflo-VTE Pump combination that provides complete capacity-control for handling a variety of petroleum liquids.

During severe cold spells the harbor of Bangor, Maine often becomes frozen over, completely halting tanker service and complicating the task of keeping the state's second largest city supplied with gasoline, fuel oil and other much needed petroleum products.

To meet this situation, the Socony Vacuum Oil Company has set up a pumping station at South Portland, 100 miles to the south. From here, a constant flow of vital petroleum commodities is delivered to Bangor, regardless of weather.

Where "Flexibility" Counts

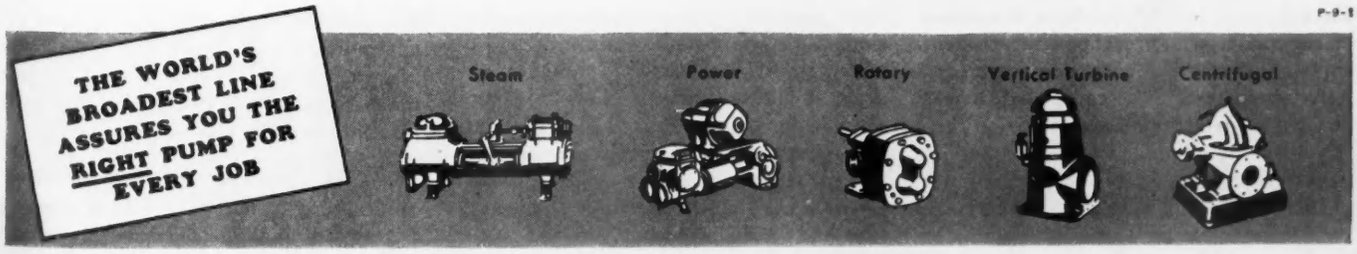
In product-pipeline service involving liquids of different viscosities, the variation of friction in the pipeline requires a variable capacity. That's why the "heart" of the Socony Vacuum station consists of two Worthington Vertical Triplex Power Pumps — a variable stroke Variflo operating in parallel with a constant stroke VTE.

This extremely flexible combination is featured by the Variflo's ability to vary its capacity, automatically and continuously, to maintain maximum allowable flow for any given liquid — as determined by the selected pressure at the governing point, and regardless of temperature and viscosity variations. Also, the Variflo-VTE hookup cuts power costs to a minimum and, being essentially self-governing, needs only periodic attention from an operator.

Worthington Variflo and VTE Power Pumps are built in all sizes up to 150 hp. For bulletins with facts proving *there's more worth in Worthington*, write to *Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, N. J.*

WORTHINGTON

P-9-1



sodium chromate per million cubic feet of gas was a means of decreasing the reduction of chromates; information obtained at this time concerning the effect of pH on lowering the rate of reduction of chromates was indefinite.

When the quantity of sodium chromate injected into the flow stream averaged 1.10 pounds per million cubic feet of gas, the excess sodium chromate in the effluent water could be detected and measured only by an analytical method because a concentration of seven ppm does not color water appreciably. Therefore, injection tests with solutions of slightly increased chromate concentration were planned that would provide enough sodium chromate in the effluent water to give it a distinctive color so that an operator could check the efficiency of the treatment by visual inspection of water from the wellhead trap. Also, it was desired to determine if the rate of reduction of chromates would be appreciably increased at higher flowstream concentrations and if the flow capacity of the tubing would be lowered.

Treatments with solutions containing seven pounds of sodium chromate and varying amounts of alkali per 100 gallons of water were begun on July 26 and were continued for approximately one month. The solution was injected at a steady rate of 21.8 gallons of water and 1.52 pounds of sodium chromate per million cubic feet of gas flowing. The effluent water contained an average of 215 ppm of sodium chromate and was definitely yellow. The 1.9 to 2.6 pounds of sodium hydroxide also injected per million cubic feet of gas maintained the pH of the effluent water at 7.7. Rates of corrosion were negligible and the flow rate through the tubing was lowered only slightly. At the conclusion of the tests on August 22, the rate of flow of gas from the well was 3.6 million cubic feet per day, and the flow-capacity factor was 0.16, indicating no change in flow capacity of the tubing after ten weeks of testing.

Effect of Injection of Relatively Small Quantities of Chromates on Corrosion Control

As shown in Table 7, all tests made during the first ten months at the well in the Cotton Valley field involved injecting ten pounds or more of sodium chromate per million cubic feet of gas. Except for a few of the tests, a surplus of chromates was present in the effluent water, and rates of corrosion were low. After these tests were completed, it was decided to determine how corrosion control and flow capacity of the tubing would be affected if a much smaller quantity of sodium chromate were injected into the well to flow with the gas. Some apprehension prevailed lest small amounts of chromates actually would increase corrosion, particularly pitting corrosion, and prove detrimental rather than helpful.

In the test begun August 22 and continued for two weeks, 0.39 pound of sodium chromate, 1.75 pounds of sodium hydroxide, and 19.5 gallons of water were injected into the well per million cubic feet of gas produced. This weight of sodium chromate was one-third the quantity that previously had been found necessary to treat the well and maintain approximately seven ppm of chromates in the effluent water. During the test there was no change in the rate of flow of gas from the well or in the corrosion rate as indicated by concentrations of iron in the effluent water (one ppm). The rate of corrosion of wellhead coupons increased from 0.001 to 0.004 ipy. Throughout the test the effluent water had a pH of 7.6 and contained a trace of sodium chromate. It is possible, of course, that part of the protection against corrosion was due to a film of sodium chromate deposited on the walls of the tubing during previous treatments.

Beginning September 4, the use of sodium hydroxide was discontinued, and only a solution of sodium chromate was injected into the well. As indicated by Figure 12, the volume of water injected each day remained the same, but the volume of water injected per million cubic feet of gas gradually decreased because the treatment increased the flow capacity of the tubing and hence the daily flow of gas from 3.6 to 4.8 million cubic feet (Sections A and D of Figure 12). The rate of corrosion in the tubing, as indicated by six ppm of iron in the effluent water, increased only slightly. The coupons exposed in the flowstream at the wellhead for one-week periods showed, by gradually increasing rates of corrosion (Section N, Figure 12), that 0.32 pounds of sodium chromate per million cubic feet of gas was not enough to build or maintain a protective coating inside the full length of the tubing and within the Christmas tree fittings.

After five weeks of the treatment, the upper lengths of tubing and the Christmas tree fittings possibly were corroding at rates exceeding the rates that prevailed before tests were made at the well. The maximum rate of corrosion ultimately attained, as measured by means of coupons, was 0.072 ipy, and there was no evidence of pitting corrosion. The important information obtained by the test was that sodium chromate in dilute concentrations does not provoke greatly increased corrosion attack; increase in rate of corrosion occurred slowly, and five weeks passed before corrosion control became ineffective at the wellhead and in the upper parts of the flow string most remote from the tubing inlet.

Results from Injecting Large Volumes of Water with Sodium Chromate

A diaphragm motor-driven pump having a maximum capacity of 80 gallons a day was used during the first year of the tests as described above. On October 24, 1946, a gasoline-engine-driven pump of greater capacity was installed so that the effect of injecting increased volumes of water into the well to flow through the tubing with the gas could be determined. Increased volumes of water in the flow stream were provided on the theory that the more dilute the aqueous solution of injected chromates, the slower would be the rate at which chromates were reduced to insoluble chromium compounds.

Accordingly, a series of tests lasting two months was carried out at different injection rates, using solutions of sodium chromate in concentrations such that the effluent water was yellow. During the first test, 1.82 pounds of sodium chromate, 2.34 pounds of sodium hydroxide, and 26.0 gallons of water were injected into the flow stream per million cubic feet of gas. As a result, the rate of corrosion of the wellhead coupons and the concentration of iron in the effluent water decreased to low values within a few days, and the concentration of chromates in the effluent water increased until in the last half of the test period the average was 780 ppm. If a film of protective chromates had been removed from the walls of the tubing in the preceding test, it was restored immediately when high concentrations of excess chromates appeared in the effluent water.

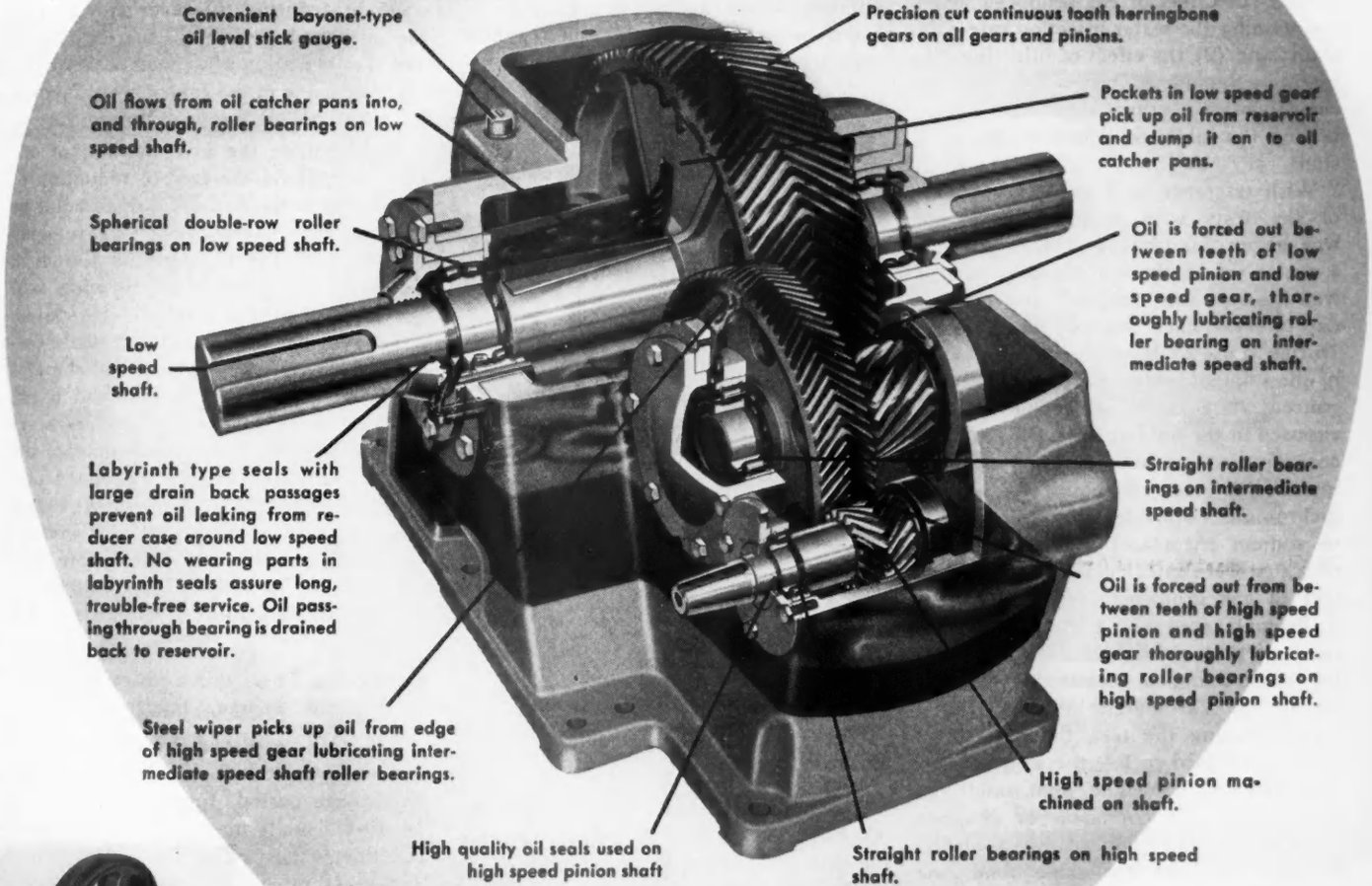
In the first of the series of tests, 26.0 gallons of solution were injected into the well per million cubic feet of gas produced, and in the succeeding three tests, the solution injection rate was increased and ultimately reached 64.9 gallons per million cubic feet of gas. At times freezing weather interfered with operation of the pump, so that it was not possible to maintain as constant an input rate as desired. However, the yellow color of chromates was always present in the effluent water, and the rates of corrosion were low. As shown by Columns 13 and 14 of Table 7, the flow capacity of the tubing was lowered slightly, and flow from the well decreased from 4.8 million cubic feet per day to 4.6. The results of the tests did not indicate that significant extra benefit was derived from pumping more than 25 gallons of water into the well per million cubic feet of gas.

Tests Using Sodium Dichromate

As brought out in the discussion of Figures 6 and 7, solutions of sodium

The Heart of Your Pumping Unit...

EMSCO PUMPING UNIT GEAR REDUCERS


Convenient bayonet-type oil level stick gauge.
Precision cut continuous tooth herringbone gears on all gears and pinions.
Oil flows from oil catcher pans into, and through, roller bearings on low speed shaft.
Pockets in low speed gear pick up oil from reservoir and dump it on to oil catcher pans.
Spherical double-row roller bearings on low speed shaft.
Oil is forced out between teeth of low speed pinion and low speed gear, thoroughly lubricating roller bearing on intermediate speed shaft.
Low speed shaft.
Labyrinth type seals with large drain back passages prevent oil leaking from reducer case around low speed shaft. No wearing parts in labyrinth seals assure long, trouble-free service. Oil passing through bearing is drained back to reservoir.
Straight roller bearings on intermediate speed shaft.
Oil is forced out from between teeth of high speed pinion and high speed gear thoroughly lubricating roller bearings on high speed pinion shaft.
Steel wiper picks up oil from edge of high speed gear lubricating intermediate speed shaft roller bearings.
High speed pinion machined on shaft.
High quality oil seals used on high speed pinion shaft
Straight roller bearings on high speed shaft.

The heart of any pumping unit is its gear reducer. The gear reducer must provide the continuous, 'round-the-clock power transmission necessary for profitable pumping. Look inside any Emsco Pumping Unit Gear Reducer and you'll see the reason for their unmatched efficiency and dependability. Bearings, gears, oil seals, shafts and oil system are all engineered to provide long, trouble-free service. And the gear reducer unit typifies the research, engineering and skilled workmanship that goes into every component part of an Emsco pumping unit. Emsco Pumping Units are available in both standard and floor-clearing models for shallow, medium or deep pumping with a range of speeds and strokes to meet all requirements. *You can't buy a better pumping unit than an Emsco!*

Adv. *43-49

Emsco single reduction gear reducer. Emsco single and double reduction gear reducers conform strictly to A.P.I. specifications.

CONTINENTAL

SERVING THE OIL AND GAS INDUSTRIES

EMSCO DERRICK & EQUIPMENT COMPANY

Houston, Texas • LOS ANGELES, CALIFORNIA • Garland, Texas

Distributors:

THE CONTINENTAL SUPPLY COMPANY, *General Offices:* Dallas, Texas

The Continental Supply Co. Limited, 216 Lancaster Building, Calgary, Alberta

Export Division: The Continental Supply Company Inc., 30 Rockefeller Plaza, New York

EMSCO

dichromate have a lower pH than solutions of sodium chromate of equal concentration. As the rate at which solutions of chromates are reduced depends to some extent on the pH, it was desired to determine how sodium dichromate would compare with the more alkaline chromate in resisting the reducing action of the hydrocarbon fluid in the flow stream of the test well. Consequently, a series of tests of three months duration, using sodium dichromate as an inhibitor, was carried out to obtain information on two variables: (1) The effect of injecting different weights of the inhibitor into the flow stream per million cubic feet of gas produced while maintaining the water injection rate constant; and (2) the effect of injecting different volumes of water per million cubic feet of gas produced while maintaining the inhibitor injection rate constant.

With reference to Figure 14, the first of the tests with sodium dichromate was begun January 14, 1947, following a period of 19 days when no inhibitor was injected into the well and a four-day interval when the well was shut in. During those 23 days the content of iron in the effluent water had increased to a concentration of 32 ppm, and coupons exposed in the fluid at the wellhead were corroding at an average rate of 0.018 ipy. For the test 1.09 pounds of sodium dichromate (equivalent to 1.19 pounds of sodium chromate) and 25.4 gallons of water were injected per million cubic feet of gas produced. The quantity of dichromate used was a little more than one-half that estimated to be necessary for maintaining a measurable concentration of chromates in the effluent water. During the test, the pH of the water decreased to 6.4, the iron content was reduced to eight ppm, and the average rate of corrosion of coupons installed in the wellhead was reduced to 0.013 ipy. At the same time, the flow capacity of the tubing decreased gradually at the rate of 0.1 percent per day.

Second Test

For the second test of the series, begun on January 25, the water-injection rate was substantially the same as that in the preceding test, but the weight of sodium dichromate injected into the well was increased to an average of 1.63 pounds (equivalent to 1.78 pounds of sodium chromate) per million cubic feet of gas produced. While the treatment was in progress, the concentration of chromates in the effluent water, measured as sodium chromate ($Na_2CrO \cdot 4 H_2O$), was 70 ppm, the pH averaged 6.2, the iron content of the water was reduced to one ppm, the average rate of corrosion of coupons exposed in the flow stream at the wellhead was reduced to 0.005 ipy, and the flow capacity of the tubing decreased continuously at the rate of 1.0 percent per day.

The third test was started February 11 to determine the effects of injecting into the well a quantity of sodium dichromate considerably in excess of that required to maintain a color of chromates in the effluent water. After the pumping rate became constant, 2.79 pounds of sodium dichromate (equivalent to 3.04 pounds of sodium chromate) were injected into the well per million cubic feet of gas produced. The concentration of chromates in the effluent water was 730 ppm, the pH of the effluent water averaged 6.4, rates of corrosion were negligible, and the flow capacity of the tubing continued to decrease.

Results from Injecting Large Volumes of Water with Sodium Dichromate

The next variable investigated was the effect of the volume of water injected with sodium dichromate on the flow capacity of the tubing. For the test that began on March 8, the volume of water injected per million cubic feet of gas was increased to 44.4 gallons from an average of 26 gallons in the three preceding tests. As shown in Table 7, the 2.09 pounds of sodium dichromate injected per million cubic feet of gas gave the effluent water the characteristic chromate color and provided complete corrosion control. During the three weeks of the test, the flow capacity of the tubing decreased at the rate of 0.4 percent per day, a result comparable with that obtained when 40.3 gallons of water per million cubic feet of gas were injected into the well with sodium chromate.

For the fifth test with sodium dichromate, started on March 29, the rate of injection of water was increased to 86.2 gallons per million cubic feet of gas produced. The 2.67 pounds of sodium dichromate injected in solution in the water provided an excess of 230 ppm of chromates in the effluent water. The decrease in the flow-capacity factor of the tubing at the rate of 0.9 percent per day during the 25 days that the test was in progress may have been due, in part, to the high concentration of chromates in the water. A comparison of this test with the third test of the series started on February 12 in which 27.9 gallons of water were injected per million cubic feet of gas shows, however, that an excess of 730 ppm of chromates in the effluent water was accompanied by a decrease in the conductivity of the tubing of only 1.0 percent per day. The two tests are similar in all respects save the volume of water injected; thus, it is not indicated that any advantage resulted from the large flow of water in the last test.

The treatments with sodium dichromate resulted in a continuous lowering of the flow capacity of the tubing at an average rate of 0.7 percent per day. During the three months required for making the tests, the rate of flow from the well decreased from 5.5 to 3.0 million cubic feet per day, and the flow-capacity factor declined from 0.22 to 0.12. The sodium dichromate gave the effluent water a pH of 6.4 as compared with a pH averaging 7.7 when sodium chromate and sodium hydroxide were added to the injected water. The consumption of chromates during the tests showed that the chemical reduction of chromates, and the formation of deposits of hydrous chromic oxide in the tubing were favored by a low pH in the flowing water.

To complete the investigation of the effect of pH on the rate of reduction of chromates in the flow stream, an aqueous solution of chromic acid was injected into the well for 17 days. As shown in Table 7, 1.65 pounds of chromic acid (equivalent to 2.67 pounds of sodium chromate) per million cubic feet of flowing gas provided 13 ppm of chromates in the effluent water, which had a pH of 5.1. Low rates of corrosion were maintained, and the flow capacity of the tubing decreased at the rate of 0.4 percent per day. The tests showed that chromic acid solutions would prevent corrosion but that they are more susceptible to reduction than chromates which provide solutions of higher pH.

Concluding Tests with Sodium Chromate and Sodium Hydroxide

The tests with sodium chromate and sodium hydroxide conducted during the five-month period, June 4 to November 14, 1946, usually maintained or increased the flow capacity of the tubing unless an excess of chromates was present in the effluent water. Subsequent treatments with sodium dichromate and chromic acid lowered the flow capacity of the tubing continuously for approximately four months, and at the conclusion of the tests the flow-capacity factor of the tubing was 0.12 and the rate of flow of gas was 2.9 million cubic feet per day. A treatment to increase the flow capacity of the tubing at some sacrifice of corrosion control had not been used at the test well for six months.

On May 10, 1947, a treatment was started using 1.46 pounds of sodium chromate, 1.95 pounds of sodium hydroxide, and 49 gallons of water per million cubic feet of flowing gas. The purpose of the test was to determine

REMOVE THE CAP . . . REPLACE THE BEAN

FASTER THAN CONVENTIONAL METHODS!

O-C-T PRODUCTION CHOKES GIVE YOU...

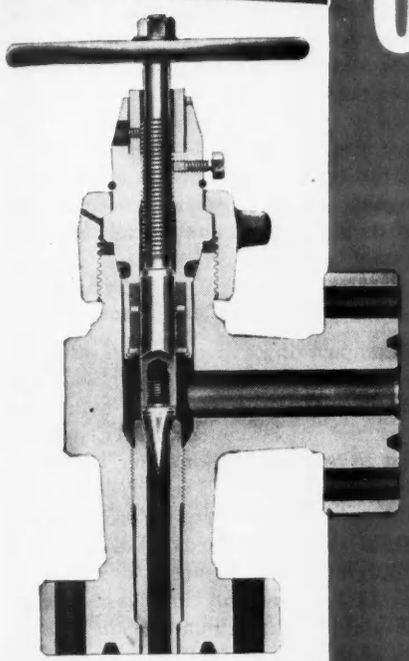
Economy — provided by incorporating an enclosed stem thread, replaceable stem point and "O" ring bonnet seal unit.

Speed — provided by the hand-tight flow cap; easily and quickly removed to change beans.

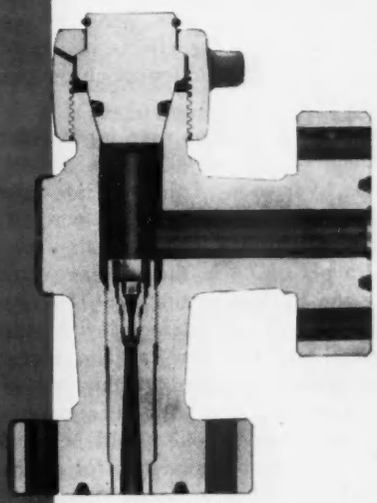
Flexibility — provided by the single body design which is convertible to either positive or adjustable flow.

Strength — provided by the rugged and compact design with strength to withstand pressures far above the ratings.

Simplicity — provided by rugged, interchangeable parts.



JW CHOKE — The enclosed stem thread and packing unit provides a short, compact adjustable choke.



PC CHOKE—this positive choke accommodates beans from .0156" to ¾" in Type FC 140—beans from .0156" to .3125" in Type FC 142 PV.

In the new JW (Adjustable) Choke and the PC (Positive) Production Choke, O-C-T engineers have incorporated a hand tight flow cap design which materially speeds up the bean replacement operation. This cap holds full body pressure when only hand tight. By simply removing the hand tight flow cap, the bean replacement can be accomplished in a fractional part of the time required by conventional methods.

In addition, this same hand tight flow cap makes the new O-C-T Production Chokes easily and quickly converted from adjustable to positive chokes. Thus, a well may be cleaned with a JW Choke and quickly switched to a PC Choke for steady production.

Added economy is provided in the new O-C-T JW Adjustable Chokes by incorporating an enclosed stem thread, replaceable stem point and an "O" ring bonnet seal unit. The same choke body accommodates the PC Positive Flow Cap and a variety of flow beans.

Check the other features of these new O-C-T Production Chokes. Talk to your O-C-T Representative or write for complete mechanical details.

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

Oil Center Tool Co.

P. O. Box 3091, Houston, Texas

Export Representatives: Venezuela, Colombia, Peru, and Ecuador—Berry & Hall, Apartado No. 304, Maracaibo, Venezuela—Sterling Areas—Le Grand, Sutcliff & Gell, Ltd., Southall, Middlesex, England. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston 1, Texas.

if the nature of the fluid flowing from the well had changed significantly with time. An increase in the capacity of the reservoir fluid to reduce chromates, for example, would modify conclusions concerning the data obtained in determining the relation between the pH of chromate solutions and the rate at which they were reduced in the tubing of the well. Except for a greater volume of water injected, the test was similar to one begun August 18, 1946. As indicated in Figure 16 and Table 7, the pH of the effluent water increased rapidly during the test from 5.1 to 7.5 when an abundance of chromates appeared in solution, and the tubing flow-capacity factor declined at the rate of 0.6 percent per day as compared with a 0.7-percent-per-day decline in the previous test. The results obtained in the two tests were similar enough to indicate that no significant change had taken place in the properties of the flowing fluid during the period when tests to determine the effects of pH of solutions on the reduction of chromates were in progress.

The aqueous solution used for the last treatment of the well contained only sodium hydroxide. Injected into the well at the rate of 1.98 pounds per million cubic feet of gas, the alkali maintained a pH of 7.4 in the effluent water during the 16 days of the test. The rate of corrosion was maintained low by the treatment and the flow-capacity factor of the tubing increased at the rate of 1.3 percent per day. Whether or not sodium hydroxide alone could be used indefinitely for corrosion control at the test well can be determined only by a test lasting several months. The test that was made indicated, however, that sodium hydroxide and related alkalies could be used in removing deposits of reduced chromates from the tubing without complete sacrifice of corrosion control.

Tubing Withdrawn from Well and Inspected

Production from the well was stopped on June 12 in preparation for removal and inspection of the tubing. Water was pumped into the tubing against pressure to fill the well and provide a hydrostatic head on the producing formation so that no gas would enter the well. The Christmas tree was dismantled, and the tubing was withdrawn from the well by means of a work-over rig. Threads in the tubinghead were found to show some effects of corrosion, and a short nipple below the tubinghead was found weakened to the extent that it had to be discarded. The remainder of the tubing string, including the bottom perforated joint, showed very little evidence of corrosion. As stated earlier in this report, the flow string had been subject to corrosion for 24 months before sodium chromate and alkalies were injected into the well, and as the tubing had not been inspected immediately before the tests, it could not be determined to what extent the corrosion found in June, 1947, occurred during the injection tests.

Production from the well was resumed June 25, and further observations of flow characteristics were made beginning July 31. The perforated joint and the 18 joints of tubing above it that were found on inspection to contain a deposit of reduced chromates had been replaced by clean tubing so that the character of flow from the well differed appreciably from that which prevailed before the replacements were made. Water samples were taken from the well and pressures and rates of flow were measured for five days. The data obtained during that time are shown in Figure 16 and Table 7. The concentration of iron in the effluent water was 46 ppm as compared with 100 ppm before the well was treated with sodium chromates and alkalies. Also, the flow-capacity factor of the tubing was 0.47 whereas it was 0.57 before deposits had formed in the tubing. It was known that a thin scale of hydrous chromic oxide covered a part of the inner surface of the tubing, and there was a difference in the rates of gas flow at the time that the factors were evaluated. When observations were made in August, 1947, after the work-over, the well produced gas at a rate averaging 6.6 million cubic feet per day; when the tests were begun in October, 1945, the well was producing gas at the rate of 8.6 million cubic feet per day. At both times rates of production were controlled by the back pressure in the pipe line and throttling at the surface.

Sand Face in Well not Obstructed by Reduced Chromium Compounds

Since a thick deposit of chromic oxide collected on the outside of the perforated joint of tubing in the well, it is of interest to consider whether such deposits also may have formed on the face of the sand to such extent that productivity of the well was lowered. In Table 8 are given the rates of flow and corresponding casinghead and tubinghead pressures for the 2d, 3d, and 4th days of August, 1947, after deposit-free joints of tubing had been installed on the lower end of the flow string in the well. The average rate of flow for the three days was 6.61 million cubic feet of gas per day. Corresponding pressure data taken in October, 1945, during the first month of the tests, when the rate of flow of the well was substantially the same as in August, 1947, also are given in Table 8. In Column 6 of the table, the difference between formation and casinghead pressures have been computed to provide a measure of the pressure gradient required to drive the gas-condensate fluid through the formation and sand face into the well. The pressure exerted by the static column of gas in the casing annulus is approximately 450 psi and substantially the same for all the measurements.

TABLE 8

Comparison of Resistance to Flow of Gas Through Formation and Sand Face Before and After Injection Tests

1	2	3	4	5	6	7
DATE	Rate of Flow Million Cu. Ft. per Day	Formation Pressure P_f, psia.	Casinghead Pressure P_c, psia.	Tubinghead Pressure P_t, psia.	P_f-P_c	P_c-P_t
10-28-45	6.57	2,945	2,078	1,926	867	152
10-30-45	6.63	2,945	2,081	1,918	864	163
10-31-45	6.60	2,945	2,093	1,956	852	137
11- 8-45	6.25	2,945	2,093	1,933	852	160
Average	6.67	2,945	2,086	1,933	859	153
8- 2-47	6.70	2,888	2,036	1,853	852	183
8- 3-47	6.56	2,888	2,037	1,855	851	182
8- 4-47	6.56	2,888	2,042	1,860	846	182
Average	6.61	2,888	2,038	1,856	850	182

Pressure Comparison

Comparison of the average difference between formation and casinghead pressures, $P_f - P_c$, determined before and after the injection treatments, indicates that to flow 6.6 million cubic feet of gas per day into the well required $859 - 850 = 9$ psi more pressure before the treatments than afterwards. Although such a difference in pressure is not to be expected and probably involves some uncertainty in the estimate of the pressure gradient, it is indicated that if reduced chromium compounds were deposited on the sand face they offered little or no obstruction to flow of gas into the well. It was estimated that the fluid entering the well during the last months of the tests contained approximately 12 percent of dry gas that had been returned to the reservoir from the cycling plant. Dry gas mixed with the reservoir fluid might lower its viscosity so that a lower pressure gradient would be required to move fluid toward the well but it seems unlikely that the decrease in pressure gradient from this cause could amount to appreciably more than 9 psi.

The averages of the differences in casinghead and tubinghead pressures shown in Column 7, Table 8, probably indicate that the inside surface of some of the tubing that was replaced in the well had been roughened with scale-like deposits of reduced chromium compounds. Although the scale was thin, it might have caused an additional pressure drop of $182 - 153 = 29$ psi in the flow string.

Reservoir Reconditioning
Conserves Water-Drive Energy

By F. R. COZZENS
Field Foreman, Equity Oil & Gas Company

WASTED energy at any point within an oil recovery setup adds materially to the cost of production, but during a process of water drive, the most expensive points of energy escape are along the flood-line, between the input wells and producers.

Field practice shows that under average conditions, only a small percentage of the driving energy pressured to an input is actually expended against the oil-bank. Most of the missing force is apparently used in overcoming structural resistance, but a significant part escapes through abandoned and unplugged shot-holes; through leaks, in and around packers and casing of producing wells; and through beds of shale or slate which may intercept the producing sand, or be located in stretches of uncased hole directly above it. These avenues not only rob a project of driving power at strategic points, but since they invariably contain and convey raw and contaminated water, many of them are capable of converting their energy into divers corrosive and plugging actions, common to flooding. Such obstructive actions are generally due to contact of a stable flood with raw water, wherein complex chemical reactions occur which have a very definite effect upon certain types of clay.

In some sandstone structures, these clays are deflocculated, and close off the smaller pores. More often, the clay structure is broken down, and certain of its components made soluble. Elements thus released are seldom forced ahead into the oil-bank, but apparently migrate backward into the flood water, where precipitants settle out, forming a gelatinous and very adhesive residue which occupies drainage space and provides an ideal breeding ground for numerous types of micro-organic growths. Infected areas are usually spotty, but may extend as far back as an input where the residue spreads gradually over the sand face. In this location, it is removable in most cases with chemicals, but no known method will dissolve or eradicate it from a sand structure. Since obstructive effects are permanent, and increase with the life of the flood, a vicious cycle is created. While the reservoir is being robbed directly of energy, sand resistance is being increased so that it becomes more laborious to recover oil.

Focal points capable of trapping energy and causing its conversion into obstructive actions are present in every area of sand that has undergone primary development. Therefore, an effective recovery of oil from such environment requires the adaptation of two essential factors: (1) A stable flood, chemically treated to provide a high degree of compatibility with the sand structure; and (2) mechanical corrections on the reservoir so as to confine the flood and direct its energy more evenly against the oil bank. Behavior of the first factor is influenced to a great extent by the efficiency of the second, and an opportune time for efficient reservoir corrections is during the initial survey of the project.

Checking for Encroachment

Eastern operators who follow oil recovery methods and trends very closely generally start their program by checking for raw water encroachment in open wells and producers already on the pumps. The first objective is to confine the driving energy to the producing horizons, and the most effective treatment for a leaky well is a packer, seated in the top of the pay strata and backed up with cement. Whether for casing, tubing, or induction pipe, the packer seat or shoulder is of vital importance. If placed too low in the sand, several inches or more of a productive zone may be sealed off and driving energy including oil will escape into the bore above it. If placed too high, the flood water may contact shales, providing chemical reactions on their clay components. Once the proper position has been established through measurement, a temporary bridge is made across the bore, 12 to 24 inches below the designated point. The walls are sprayed with cement slurry to a distance of three feet above the bridge. The packer is run and seated during the slurry's initial set. Shale beds or deposits, one foot or more in thickness, located between zones of productive sand, are also treated with cement slurry against water action. Three or more applications, given six to eight hours apart, are generally necessary for an effective job. Where intervening shale beds or slate deposits produce considerable water, it is often necessary to use a plugging agent (plastic combination) in connection with cement. Some of the newer, commercial plugging agents are proving very effective for such jobs, as well as for sealing off brines and mineral waters, above or below an oil-producing zone. In many depleted wells, the sand boreface has been fissured or distorted by shooting so that an adequate bridge across the annulus is an impossibility. In these cases, the problem is often solved with drillable pipe, one inch less in diameter than that of the bore at the final reducing point. The pipe is plugged at the top end, and cut to a length sufficient to reach from the base of the shot hole to the desired distance in the upper sand. A wadding of burlap or similar material tamped down upon the plugged end is usually sufficient to retain green cement for a shoulder job, or to catch seepage from wall spraying. The cement is drilled through, after initial set, and pipe is drilled out or destroyed with acid.

Shot holes of many old but still productive wells were provided with pockets, ranging in depths of 150 to 200 feet below the base of a pay sand. Deep pockets invariably penetrate shales and various other clay formations which are waterlogged, and serve also as receptive havens for corrosive elements, iron oxides (scale) and bacterial growths. This residue is being raised constantly into the shot hole with the rise and fall of fluid during the process of pumping, and is a major factor in spreading plugging materials over the sand-face. Corrective treatment is to plug off one-half to two-thirds the lower distance of pocket, and fill the remainder to the base of the pay sand with cement slurry, the slurry being

introduced by dump-bailer, or through a string of two-inch diameter line pipe. After its initial set, the cement is drilled through to a desired depth, (12 to 20 feet) with a smaller diameter bit.

Under certain conditions in the processing of leaky wells, it is not practical to use packers. The usual requirement is a new shoulder, constructed in the top of the pay strata, upon which the inner string of casing already in the well is lowered. For these jobs, jacks are generally necessary to lift the casing so that an underreamer can be used to cut out the old shoulder, and enlarge the bore diameter to the new one. If the casing refuses to settle into position by its own weight after reaming is completed, the process is encouraged by forcing a plug down the casing to a base in the bottom section. The casing is then filled nearly to the top with water, and an electric heating unit is inserted down the pipe. Temperature of the fluid is raised to the boiling point and is held to approximately that degree for three to six hours. Contraction of the metal upon cooling usually releases the grip of crystallized sediment around the pipe, allowing it to settle. Heavy jarring with the drill or the use of drive clamps for seating casing are risky, and often expensive procedures, unless the pipe is known to be in first-class condition. Where condition of casing is questionable, the most approved practices are, first, running an inside string on a reenforced shoulder; second, removing the casing, replacing bad sections, and re-running the pipe.

During the repairing of producing wells, the reconditioning operator takes samples of the waters encountered, so as to acquire a practical working knowledge of their origin, nature, and their possible behavior on the prospective flood. Such knowledge is essential for later reconditioning work, and for making the action of the flood more effective. If at all possible, water samples should undergo laboratory analysis. Much also can be learned on the job from the nature and appearance of the fluid. Surface water, encroaching by a direct avenue, such as an open well bore, is usually clear, odorless, and of low calcium content. Its most objectionable properties are dissolved oxygen, algae, and bacterial growths. Upper lime formations yield water of similar appearance, except the calcium content is greater, and a milky scum often appears on the surface when the sample remains undisturbed for a few hours. Rainbow-tinted water having a strong odor of sulfur indicates the presence of coal deposits at shallow depths. This water is very corrosive.

Water from the deeper shales is generally tinted by the weakest and most soluble constituent. Predominating colors are dull red, green, and greenish-gray. Among its most objectionable features are solubles which unite through chemical actions to form precipitants. Black or coffee-colored water issuing from shales often indicates the presence of a very potent and stubborn type of bacteria, commonly termed "black bacteria." When the odor of such water is very rank and fetid, its origin is generally an unplugged shot hole in the immediate vicinity.

Slow filtration of water through an oil-bearing sand can seldom be cased off. Chemical analysis of all such fluids is essential, however, so that a flood can be treated or tailored to counteract objectionable properties as far as possible. Prominent among sandwaters are highly-concentrated brines, especially those having a chloride content in excess of 250 parts per million. Under pressure, such water forms heavy deposits of salt, and often sodium scale and magnesium. Sulfates, usually combined with sodium, calcium, or magnesium, are generally present in sand water, and are contributors to plugging actions in certain flood compositions. Sand seepage, high in calcium carbonate, when pressured out of its natural zone, is capable of converting sodium clays into calcium clays, making their expansion or deflocculation more pronounced. Sand water, slimy in appearance and which becomes foamy by agitation, is often the aftermath of an old air-drive upon the property. Soft, mushy, and gray-colored sand cuttings usually indicate an old flood, or the encroachment of edge water. Watered-out sand is difficult to detect, however, from samples taken on the job. Proof, and some field history of former water drives, air or gas repressuring, or vacuum operations are essential before any new flood is started.

Sealing Abandonments

Only a small percentage of dry holes or abandoned producers is likely to disturb seriously a water flood and treacherous ones are generally located during the repairing of existing wells. Where the job can be carried out, the most effective method of sealing an unplugged abandonment is to re-open the annulus to its base, tamp the shot hole with clay, and place an air-tight, reinforced plug in the top of the pay sand. The bore is then filled to the surface with finely pulverized clay, and tamped. If there is probability of the well being re-opened later and used as an input or producer, steel-line measurements from surface to sand top should be taken, intervening formations noted, and the sand plug made of plastic, or other drillable material.

In abandonments where treacherous bore walls prohibit reaching the sand, sealing off is usually accomplished by inducing caving in some formation as close as possible to the sand top. Caving is induced, usually, by chemical heating agents or explosives. The procedure is to bridge the bore immediately below the formation to be treated, and if chemicals are used, 20 to 50 pounds of caustic soda (lye), or 50 pounds of calcium carbide are introduced into the formation-zone through a string of line pipe. Introduction of the required amount of either chemical is followed by pouring 30 to 50 gallons of water down the pipe. The operator should never inhale fumes issuing from the pipe. Fumes, especially from the union of carbide and water (acetylene gas), are both toxic and inflammable. The explosive used generally to induce caving is gelatin-dynamite, in packs of 25 to 50 pounds.

The loading procedure is to remove the wrappers from the required number of cartridges, and dip the raw cartridges in oil or grease. These are placed, end to end, in an ordinary nitroglycerin dumpshell, lowered to the desired position, and the load released. The explosive then forms in a solid pack, without any tamping, and is detonated by squib (go-devil), or by the use of an electric blasting cap and line. Sufficient caving usually follows a single treatment of either chemical agents or explosives, and the remainder of the bore is filled in with clay. Partial, or temporary abandonments (wells not pumped, but still retaining casing) require close checking for water encroachment. If such wells are to remain dormant over a long period of time, the safest procedure is to set a drillable and air-tight plug in the sand top. All depleted wells, dormant or otherwise, should be cleaned and washed out with water, chemically treated, before being included in a flood pattern.

Many corrosive and plugging actions common to a water flood are not clearly understood, therefore they can not be controlled by any rule-of-thumb formula. Factual evidence is sufficient to prove, however, that any factor that tends to unbalance the compatibility between flood water and sand structure also increases resistance, and detracts in many other ways from an oil recovery effort. It is likewise proven that certain elements, ever present in an area of depleted sand, are capable of unbalancing a stable flood and disrupting its harmony with sand structure. To obtain a more effective control of these adverse elements is the basic objective in reservoir reconditioning. During the processes in making reservoir corrections, the operator acquires field knowledge which enables him to provide a flood more easily adapted to specific needs. Water action within the structure is more uniform. Less driving energy is wasted, and as a result, more oil is gained at a faster rate with less expense.

How to do it!

PRODUCTION HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

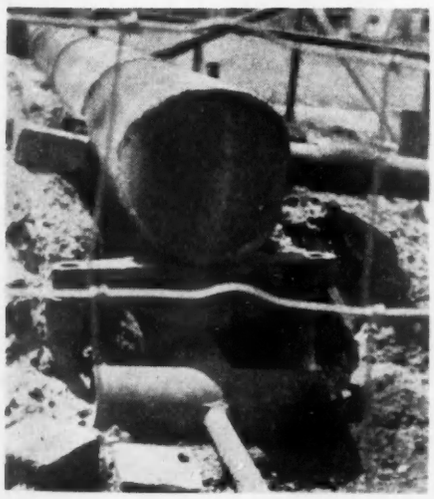
HOW TO—Build Scrubber in Shop

When it is possible to use gas from a high-pressure gas well for gas lifting or other lease use, it is necessary that all entrained fluids be removed to prevent freezing of regulators, intermitters, etc. If the fluids fall out rather easily, a device such as the one shown will serve to clean the gas effectively.

Made of six-inch pipe with orange peel welds on each end, it rests on stands about six feet off the ground on one end and two feet at the other. Into the orange peel welds are inserted two-inch nipples and welded. The nipple in the upper end extends two feet down the middle of the pipe so as to direct the flow of gas down toward the lower end where the bleeder connection is made. The outlet is welded to the top of the pipe so that the gas must reverse its direction of flow and rise approximately two feet to flow to the outlet. Unions are placed on both the inlet and the outlet so that the scrubber may be taken out of service and disconnected if necessary.

HOW TO— Make Burner for Heater

When one or two wells begin to "cut" salt water emulsion, the installation of elaborate crude oil treating equipment may be delayed by using a 12-inch pipe heater and burner as shown. Wells which make emulsion are connected to the 12-inch pipe which has been capped on both ends with a section of the pipe itself.

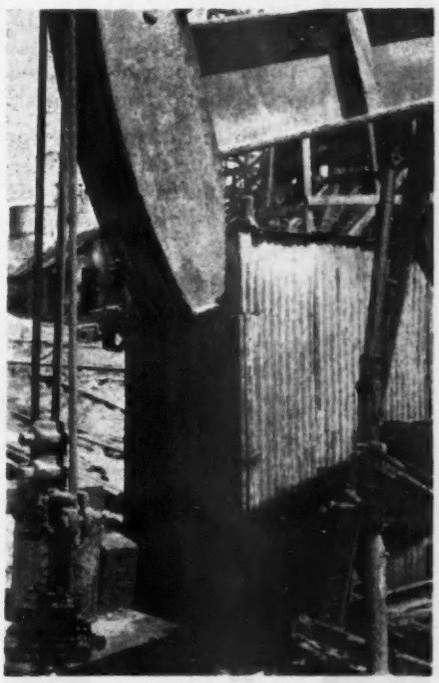


The burner is of the blast type and is constructed from four-inch pipe welded into a tee shape, with the cross piece approximately 14 inches long and the other 20 inches. A two-inch inlet line is swedged down to three-quarter inch which extends up into the throat of the burner three inches. The three-inch nipple is welded shut on one end and a one-eighth inch hole drilled in the center. The entire assembly is then inserted in a hole cut into the back end of the four-inch tee as shown and welded.

Using ten pounds (or more) gas pressure, the small hole makes a jet and the air is drawn in through the ends of the tee, and a blue-white flame is formed. A long pit lined with bricks keeps the flame on the heater, and many months of service may be expected.

HOW TO— Rig Connectors

Various types of connectors have been devised for tail-pumping fluid by means of a take-off from the under side of the walking beam of a pumping well. One operator found that excellent use could be made of a short length of pipe fitted at top and bottom with flexible links, the latter made of salvaged sections of heavy rotary chain. The upper link is welded to the beam and the lower one welded to the pump rod as shown.



Flexibility of the links permits the unit to be operated without tendency to "cramp" the connector link on the bottom of the stroke. If the unit has to be disconnected for well pulling or servicing of the tail pump, it is necessary only to drive out the pin in one of the links. Such an installation can be fitted to any type of walking beam without need for special tools or materials.

Miller

SAND PUMPS

Standard Clean-out Tool for 25 Years

Check any oil field in the world where sediment or sand is met with and you'll find Miller Sand Pumps and Bailers are standard . . . leadership earned and held by continuous improvements during 25 years of service!

The Miller Sand Pump is made in Regular and Heavy Duty types in sizes listed below. Lug type Chisel, Sand and Bailer Bottoms are easily interchanged.

Threaded Chisel and Sand Bottoms can be supplied, to permit larger pieces of sediment to pass, and pump to be dumped without removing bottoms. Tool Pin bail allows tools and sand pump to be run on same wire line when desired.

Write for new descriptive price list on Miller Sand Pumps and Bailers. See Composite Catalogue page 2666 for details.

SAND PUMP AND BAILER SIZES:

Outside Diameter
2½"
3"
3½"
4¼"
5"
5½"
7"

Lengths
20 feet
25 "
30 "

Special Sizes and Lengths to Order!

EXPORT OFFICE
30 Rockefeller Plaza
New York 20, New York

MILLER SAND PUMP CO.
1524 S. E. 29 • Box 4516
OKLAHOMA CITY 9, OKLAHOMA

HOW TO—Build Rod Line Pump Jack

A simplified method of constructing a one-to-one ratio rod stroke pumping jack and a rod line multiplier is shown. The pumping jack is an A-frame structure which supports a large wheel over which the rod line bridle rests. The wheel which changes the direction of pull is made from a piece of channel iron that has been formed into a circle about three feet in diameter. Since the well is a shallow one, the load that must be lifted is relatively light and only four two-inch pipe spokes were necessary. These spokes terminated on an axle which was supported at either end upon roller bearing blocks. These blocks in turn rested upon a flat pedestal at the apex of the A-frame support. Foundation for the A-frame consisted of heavy timber placed directly upon the ground adjacent to the stuffing box.

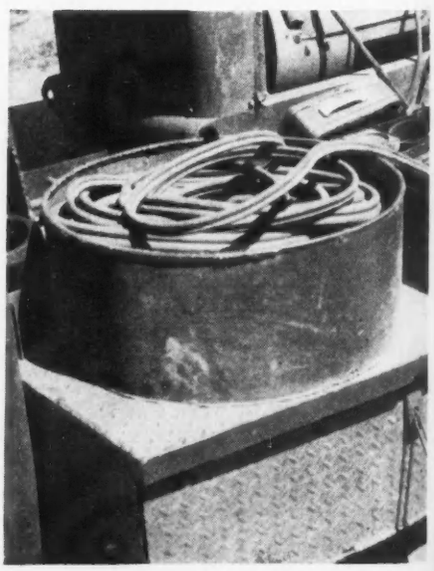
The bridle supported the rod string by the polish rod grip, and terminated several feet beyond the rotating wheel where a swivel joint connected it to the rod line. Instead of multiplying the pump stroke, the rod line was connected to the swing arm of a shop-made rod line multiplier in such a manner that the stroke was actually decreased.

The swing arm was supported from a cross bar which rested on two vertical pipe supports mounted in concrete foundations. The pull rods were attached to the swing arm just below the pumping jack connection to provide the desired reduction in pump stroke. This unit was simple to make and is sturdy enough to perform the job. Little maintenance is required, and it is light enough to be moved away from the stuffing box to make way for a pulling unit.

HOW TO—Make Tub for Hose Storage

A type of acetylene hose storage which welders have found to be convenient and with certain advantages over other types, is illustrated. A circular tub made of light sheet metal is welded to the steel bed of the welding truck. Measuring approximately 30 inches in diameter by 12 inches high, the tub has ample capacity to hold the extraordinarily long hose frequently used in field welding work. A piece of round steel bar is welded to the upper edge of the container to stiffen that edge and eliminate possibility of cutting the hose.

Connection with the oxygen and acetylene bottles is made through a small opening cut in the bottom, back side of the tub. Designed to fit into the swiftly moving operations associated with field construction and maintenance work, the tub is preferred by the welders because the torch can be picked up and taken away "on the run," and the hose will come out of the tub without kinking or snagging. Hose is easily and quickly coiled in the tub when operations shift to a new location.



McEVOY Flange Protectors

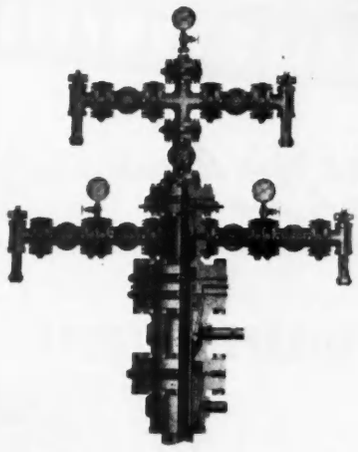
prevent corrosion of ring gaskets and studs between flanges...

McEvoy Flange Protectors eliminate corrosion of studs and ring gaskets from external causes such as salt water spray, hydrogen sulfide gas or similar corrosive gases or sprays.

Easy to install, the protectors are slipped around the flanges and tightened in place. Grease is then injected into the area between the flanges through Alemite fittings, and gaskets on the inside of the protectors prevent loss of grease.

McEvoy Flange Protectors are simple, reliable and low in cost. They pay for themselves many times over when installed on trees subject to external corrosive agents. Write for full details.

McEvoy Flange Protectors are made to fit any API flange series and size.



For greater safety and lower replacement costs on corrosive wells

McEvoy Flange Protectors are fully covered by patents . . . and are manufactured by McEvoy — exclusively.

Specify **McEVOY All-Stainless CHRISTMAS TREES and VALVES**

Sold through all leading supply stores.

McEvoy COMPANY

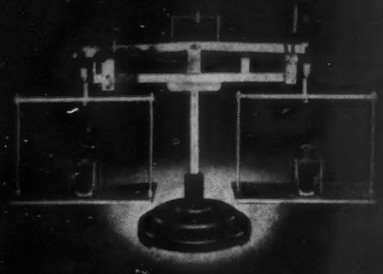
ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

TEXAS AND MILBY ST. • P. O. BOX 3127 • HOUSTON 1, TEXAS

Export Representative: E. F. Gahan, Inc., Room 1223, 500 Fifth Avenue, New York, N. Y.

PRECISION BALANCE

100 Milligram Sensitivity



For general precision weighing of heavy loads. 100 milligram sensitivity with 30 pound load. Suitable for specific gravity determinations with pressure picnometers. Equipped with microscope for accurate balance reading.

CIMCO

COLEMAN INSTRUMENT

and Manufacturing Company

716 SOUTH TROOST TULSA, OKLAHOMA

CARTER CARTER

PUMPING PROBLEM?

Dependable service—day after day . . . for every pumping job in the oil fields . . . actually at lower cost! Designed and engineered to give you continuous heavy-duty performance—with "fuel-miser" economy and "zero" maintenance. That's the 52-year record of Carter Humdinger pumps.

Humdinger PUMPS

BUYERS' GUIDE

Get your free copy today—24 pages—complete information and engineering data on our complete HUMDINGER line—Gasoline and Electric driven—sizes from 1½" to 8"—capacities from 4½M to 125M GPH. Call, write or wire our Midwest office: 210 No. Main St., Tulsa, Okla., or direct to our main office, 202 Atlantic St., Hackensack, N. J.

RALPH B. CARTER COMPANY
HACKENSACK, N. J.

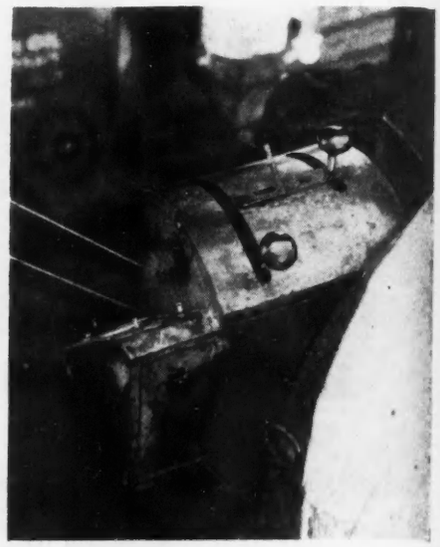
PRODUCTION HINTS

HOW TO—Lock Air Clutch Controls

On some well pulling units the arrangement of air clutch control levers is such that there is a possibility that the well puller might inadvertantly grasp the drawworks clutch lever when he meant to operate the sand line clutch control, or vice versa. Such an error, at a critical moment in the pulling operations, conceivably might result in a serious accident or injury to personnel.

One well puller, in attempting to eliminate the occurrence of such an incident, fabricated a small sliding lock arrangement that allows only one or the other of the levers to be operated at one time. The flat sliding lever has a notch in each end that will engage either lever. When one lever is in use, the other is locked in neutral position. A short stub of round steel bar welded at a 45-degree angle to the sliding member, provides an easily grasped handle with which the lever can be shifted quickly.

The device is simple to construct, and the added element of safety that it provides to the well pulling crew and equipment is ample reason to install one like it, or constructed on the same principle, on all types of pulling units.



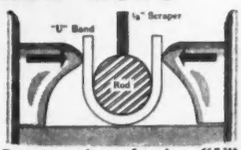
KEEP YOUR WELLS PUMPING!

Eliminate Paraffin Accumulation the LOW COST way with...

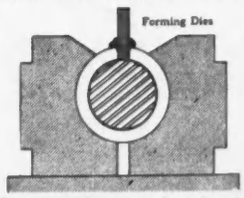
CRALL SPIRAL SCRAPERED RODS

Order from your Supply Store or Write or Wire Us for full descriptive literature.

CRALL Spiral Paraffin Scrapers fit any sucker rod. They are NOT welded to the rod (see illustrations at right), but stay firmly in position to keep tubing free from paraffin. CRALL Spiral Paraffin Scrapers are made to fit 2" and 2½" tubing, and can be attached to your sucker rods at our fabricating plants. The *original* installation is the ONLY cost.



Cross section showing "U" band being die-formed around rod to scraper blades.

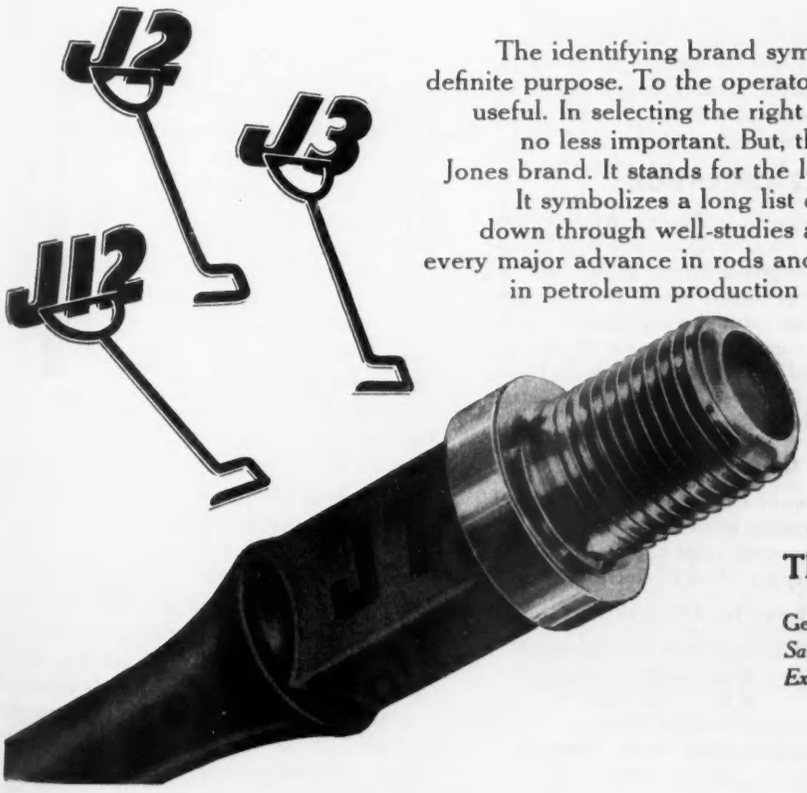


Cross section showing band held under pressure around rod while ends of band are shrink-grip attached to scraper blade.

PETROLEUM SPECIALTY CO.
P. O. BOX 1640, PAMPA, TEXAS

Manufacturing and Fabricating Plants at Pampa and Sundown, Texas

A BRAND WITH A MEANING...



The identifying brand symbols on each Jones sucker rod serve a definite purpose. To the operator who keeps rod records, they are especially useful. In selecting the right rods to run in a particular well, they are no less important. But, there is a far more important meaning to the Jones brand. It stands for the leadership of more than half a century.

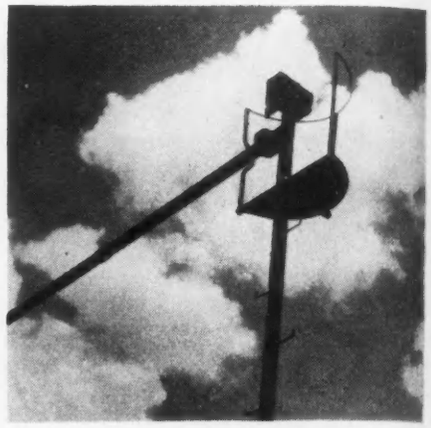
It symbolizes a long list of "firsts" from the first all-metal sucker rod down through well-studies and research and includes practically every major advance in rods and their use. It is instantly recognized by those in petroleum production as a mark of quality in sucker rods.

THE S. M. JONES COMPANY
(Subsidiary of Buffalo Bolt Company)
General Office and Factory: TOLEDO, OHIO
Sales Office: Kennedy Building, Tulsa, Okla.
Export Sales Office: Buffalo International Corp.
50 Church Street, N. Y. C.

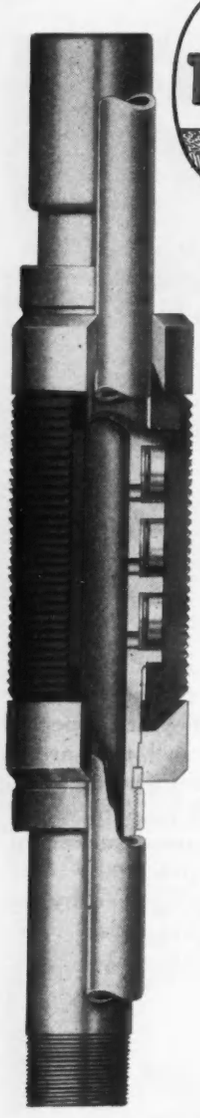
HOW TO—
Service Vent Lines

The vent line is an important part of every tank battery and probably the part that receives the least attention. One company makes it easy for the pumper to service the relief valve and lightning flame arrestor by providing a crow's nest and steps up the vent line riser. Once a month the pumper is instructed to remove the hood over the pop valve and see that it is working properly.

The steps are made by welding short pieces of sucker rod material to the side of the vent line on each side. The crow's



nest is made from a semicircular piece of boiler plate and additional sucker rod material is used to make the guard rail.



PAGE TYPE "C" TUBING ANCHOR

PAGE TENSION TOOLS

NOTE ...TO "FREE PUMP" OPERATORS!

SMOOTH OUT YOUR TUBING TROUBLES with this PAGE TYPE "C" TUBING ANCHOR...

It's *designed* for parallel strings!

The Page Type "C" Tubing Anchor is designed specifically to anchor parallel strings in "Free Pump" installations. Its advantages to operators are many. The Page Type "C" Anchor *assures* a fast tubing run-in without danger of accidentally setting slips, *eliminates* the human element of top-hole manipulation in setting and *saves* valuable time in landing tubing strings. The Page Type "C" *relieves* tubing of fluid and working pressure loads and *increases* the factor of safety in long tubing strings. It enables running longer strings of second grade tubing because the Type "C" *supports* the tubing and holds it in tension, free of "working" loads.

SIMPLE OPERATION

The Page Type "C" Tubing Anchor sets hydraulically on fluid pressure differential. The hydrostatic head of oil in the power string together with the "free pump" surface operating pressure, forces a series of small pistons against v-cut slip segments that grip securely against the casing. Holding power of the slips far exceeds fluid head and operating pressure loads. Release and removal from well requires only drainage of tubing. Tool can be run-in either end up.

SIMPLE CONSTRUCTION

Anchor Body made from a solid billet of steel . . . working force consists of two v-cut slips and six pressure-sealed pistons . . . all parts replaceable and interchangeable.

WRITE now for details or see . . .

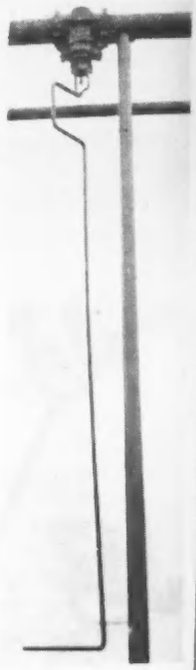
Mid-Continent Distributors

D+B Division—Emsco Derrick & Equipment Co., Garland, Texas

The Continental Supply Company Dallas, Texas

PAGE OIL TOOLS, Inc.
3356 Lime Ave., Long Beach 7, Calif.

HOW TO—
Offset Valve Stem

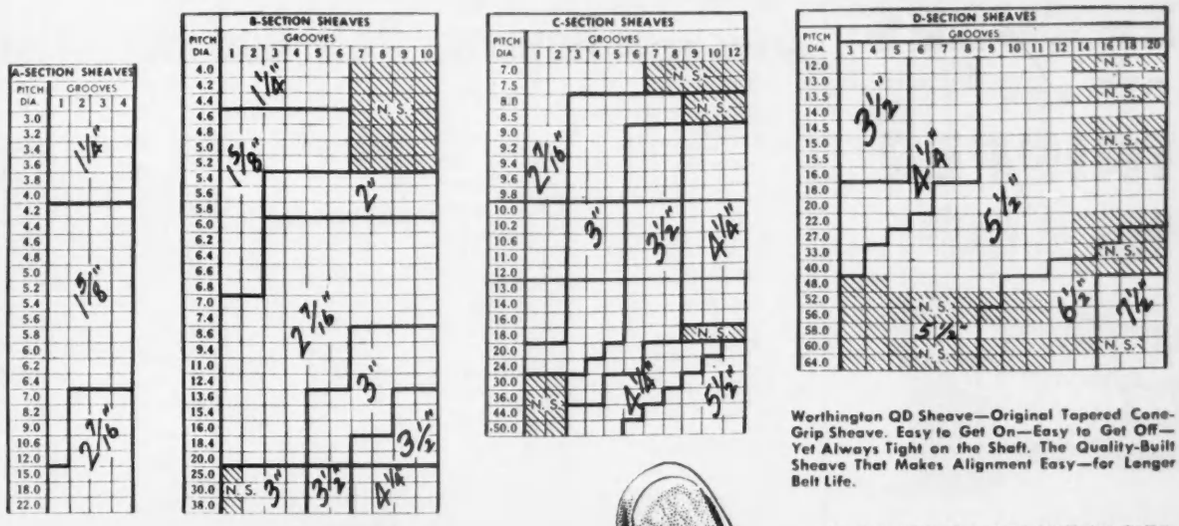


If it becomes necessary to install a plug valve in a pipe line which parallels another immediately below it, the plug valve can be set into the line up side down with the wrench square positioned on the underside. Since the bottom line is in a position to adversely affect the operation of the valve with an ordinary long extension valve handle, the difficulty can be overcome easily with a similar extension handle, but with a sharp U-bend at the point where the long rod would strike the lower pipe line.

The extension valve handle is attached to the plug valve wrench square with a box fitting, using a set screw to retain it permanently. Two parallel arms, one on each side of the box, are shaped to weld the extension handle to these arms so the lubricant screw can be repacked when inserting a stick of compound. Near the lower handle of the extension valve stem is a strap attached to the pipe line supporting post so the valve can be operated easier and to prevent the handle from swinging free.

THE GOOD RIGHT HAND OF INDUSTRY

STOCK SIZES WORTHINGTON HEAVY DUTY "QD" SHEAVES WITH MAXIMUM BORES INDICATED



Worthington QD Sheave—Original Tapered Cone-Grip Sheave. Easy to Get On—Easy to Get Off—Yet Always Tight on the Shaft. The Quality-Built Sheave That Makes Alignment Easy—for Longer Belt Life.

N.S. DENOTES NON-STOCK SIZE

to deliver your sheave immediately

As long as it takes our distributor's shipment to get there is as long as it takes—in most cases—to get exactly the sheave you need into your hands. Your Worthington distributor has practically any stock size you'd ever call for—if he hasn't, one of the Worthington warehouses will get it to him in 24 hours or less.

Check your sheave requirements. With more sheaves listed as "stock sizes" and more sizes in stock than any other distributor, your Worthington distributor may be able to save you the cost of a special sheave.

Top-ranking distributors in the oil fields handle Worthington QD Sheaves and Worthington-Goodyear V-belts. They are backed by Worthington warehouses whose stocks duplicate the factory stock at Buffalo—more sizes stocked than any other sheave on the market. With 853 sizes in "A", "B", "C" and "D" section, ½ to 600 hp, you can fill almost any rpm requirement with a *stock* sheave. Also: 332 listed stock sizes of EC Cord V-belts.

So, when you need sheaves, call your local oil-field dealer.

For Balanced Drive Performance

Specify Worthington Multi-V-Drives, with QD Sheaves and Worthington-Goodyear EC Cord V-belts. (Goodyear EC Cord or Steel Cable V-belts are used exclusively in Worthington Multi-V-Drives.)

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION
MULTI-V-DRIVE SALES DIVISION
Buffalo, New York—General Offices: Harrison, New Jersey

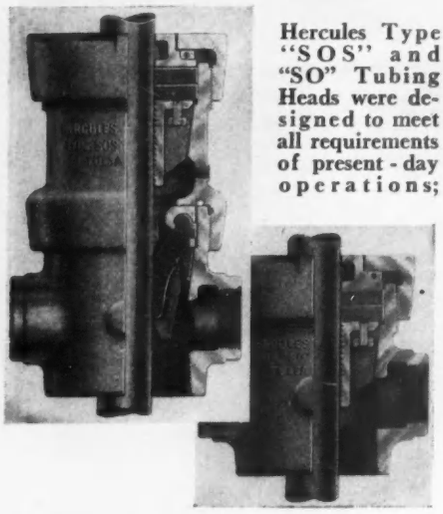
The Good Right Hand of Industry

POWER TRANSMISSION: sheaves, V-belts, variable speed drives
PUMPS: centrifugal, power, rotary, steam
AIR COMPRESSORS: water-cooled, air-cooled

NEW

HERCULES
"SOS" and "SO"
STRIPPER
HEADS

DESIGNED BY THE MEN WHO USE THEM...



Hercules Type "SOS" and "SO" Tubing Heads were designed to meet all requirements of present-day operations; upon the opinions and suggestions of roustabouts, drillers, pumpers, engineers and other field men, as to what design and important features should be included in an ideal Stripper Tubing Head.

When you need Tubing Heads, order those that assure you improved performance and economy—Order Hercules "SOS" or "SO" Tubing Heads.

Write for Bulletin No. 229-SOS

SOLD AT ALL SUPPLY STORES

California Representative:
L. T. (Ted) WALTIMIRE
Ph. 4-4169 P. O. Box 1612
BAKERSFIELD, CALIF.

HERCULES TOOL TULSA

HERCULES
TOOL COMPANY
Manufacturers of Oil Field Equipment
General Office and Plant:
17th and Phoenix
P. O. Box 286, Tulsa 1, Oklahoma
Cable Address "HERTOCO"
Telephone 3-1186

PRODUCTION HINTS

HOW TO—Reverse Pull Rod Direction

During the declining stages of a pumping field or lease, some wells must be abandoned due to water encroachment, or other reasons. In the case where a central pumping unit has been installed, and the pumping wells have been balanced according to their location and load, these abandonments bring about a problem of re-balancing the load on the central pumping unit.

Illustrated is a central pumping unit furnishing power to pump several wells on one lease. The photograph was taken from that side of the lease where wells had to be abandoned many years after the pumping unit was installed. In order that the entire unit, which was set in concrete, would not have to be moved to a more centrally located point, the operator constructed this unique 180-degree rod pull swing.

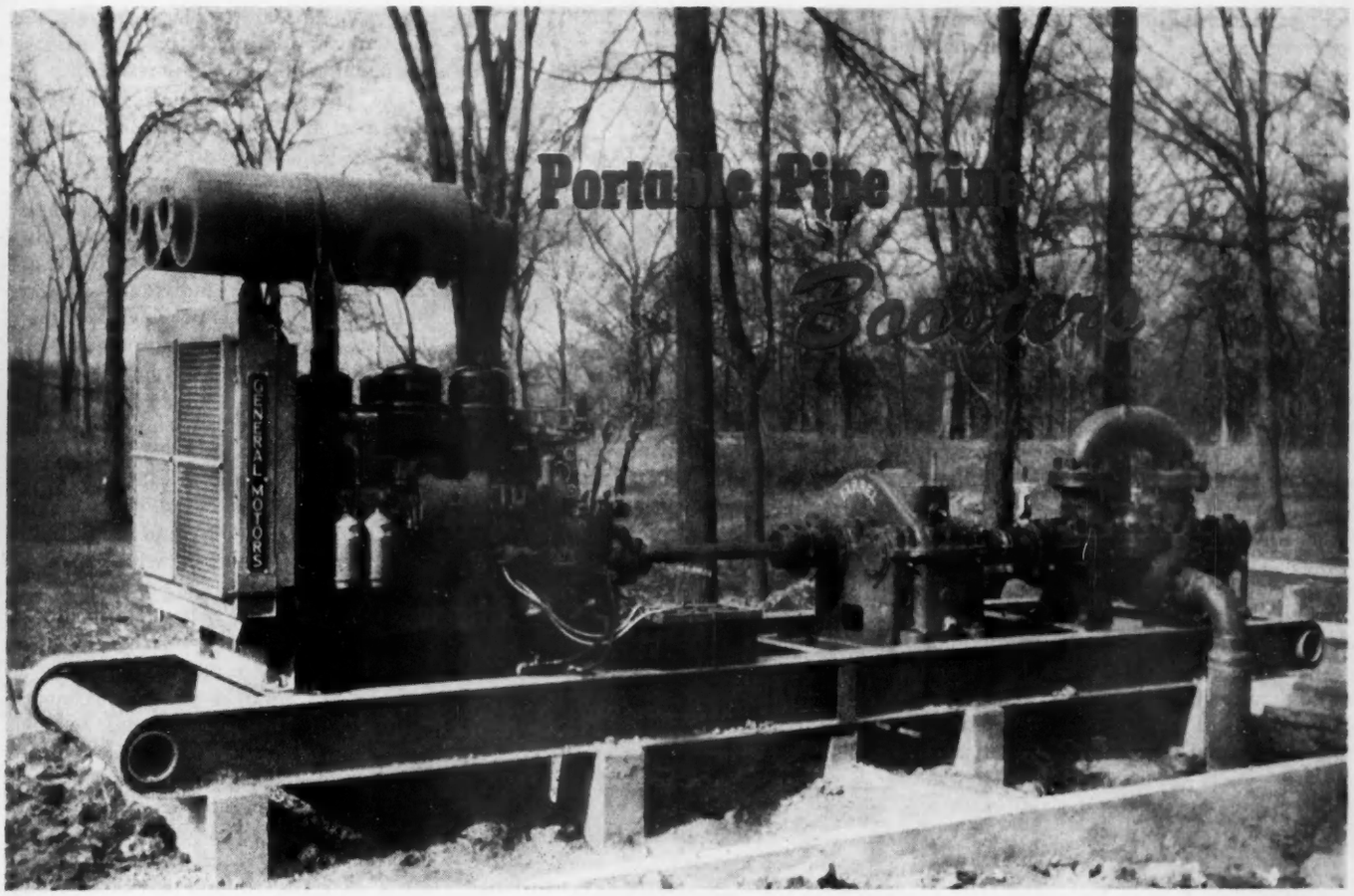
The reverse swing was made from four-inch pipe reinforced with salvaged rod lines. A vertical section of four-inch pipe was set in a concrete foundation and supported with a guy wire anchored in the foreground. A five-inch piece of casing served as a bearing which fitted over the vertical pipe. This bearing was welded to the cross arm and into the rod supporting device. Bolts through each end of the cross arm connect to eyes in the pull rods to transfer the direction of pull so that wells on the opposite side of the central pumping unit could be pumped and the load on the pumping unit could be balanced. Simple in design, this 180-degree swing requires only an occasional oiling to keep it in operation.

HOW TO—Construct Rod Line Support

Here is a simple idea for supporting pull rods powered from a central pumping unit. This "poor boy" rod support permits the pull rod to swing in two directions; in line with the direction of pull, and to a smaller extent, at right angles to the line of pull.

The support is made by driving a salvaged piece of 2½-inch flow line into the ground at an angle of approximately 70 degrees with the horizontal. Top of the pipe is at a convenient height, about four feet above ground. A piece of sucker or pull rod is cut to a length which will support the moving rod at the desired distance above ground. It is bent in reverse directions at either end so that one end hooks into the open end of the pipe support. The horizontal pull rod rests in the hook provided at the other end.

Portable Pipe Line Booster



Skid-mounted, portable booster pump. This diesel power plant delivers 260 continuous horsepower at 900 revolutions per minute shaft speed and is mounted on a skid-type structural steel base with a four-stage centrifugal pump. Drive from engine to pump is through a speed increaser at 3000 revolutions per minute.

By FRED B. CRANDALL
Products Pipe Line Department, Phillips Petroleum Company

THE St. Louis-Chicago section of Phillips Petroleum Company's eight-inch products pipe line was first placed in operation in 1939. At that time it was felt that adequate provisions for future expansion of the system had been incorporated in the design. The line had four pump stations about 65 miles apart and each equipped with two centrifugal pumps in series driven by 300-horsepower gas engines, burning butane fuel. In addition to providing for added pumping units at each station, connections were provided for addition of units at four future station sites.

In the last ten years there have been many major changes in thought about pipe line design. Small engines, closely spaced stations, and small pipe were once accepted as a standard pumping arrangement. However, the trend in all new construction has been to large engines, large pipe, and wide station spacing. By the time Phillips needed to increase the capacity of the St. Louis-Chicago section, the closely spaced stations and numerous small units were already proving to be something less than desirable because of the operating cost. However, increased capacity was desired immediately and at the most reasonable investment outlay.

Temporary Booster

Obviously, obtaining the capacity increase by looping of the line was desirable rather than by adding stations, but pipe was scarce and unobtainable at mill prices in the size and quantity needed. Therefore, some type of temporary booster station became more attractive. This would carry the overload until such time as product movements slackened or pipe became more available. Since slackened demand seemed quite improbable and a fully eased pipe situation seemed years away, serious consideration was given to the temporary booster idea. There were various fittings already installed at the future station sites to permit easy connection of new units to the line. The property at the sites was already owned or leased. With these points in mind, the study began.

Any desirable booster unit should be usable at a later date when the looping program would be completed. It should be portable enough to allow transporting from one location to another without major disassembly. A unit of this type could be used at any point on the system to replace units down for repairs for any length of time, or it might be used to provide a temporary station should a main-line station be lost due to fire, windstorm, or other cause.

Electric units were not considered since power was not readily available at the proposed station sites, nor could it be expected to be readily available at any site where the pumps might be needed at some future date.

Gas engines could have been used with butane fuel, but natural gas was not readily available at the proposed station sites. Butane fuel would require pressure storage which would be both bulky and heavy in weight. The first cost of this storage would be high, and the arrangements for supplying the fuel would be difficult. Butane movements through the

line, particularly in the summer, were so irregular that considerable storage would be required. Local delivery by tank wagon was not available.

Thus, the fuel supply more or less decided the type engine to be used. Diesel fuel could be stored in small, light, portable tanks. Local delivery by tank wagon was available at any location on short notice. Therefore, first consideration was given to the diesel engine as a prime mover for these temporary stations.

The final design called for a single steel skid with engine, gear, and pump mounted thereon. As a matter of economy the standard gears and pumps as used on units at the regular stations were used on the portable units since these were already available in company stocks. The engine selected was a twin six-cylinder, two-stroke cycle high-speed diesel delivering a total of 260 horsepower (continuous) at 900 revolutions per minute of the single stub shaft through a built-in gear box. The twin engines turned at 1600 rpm. This unit was small and light with a fan and radiator water-cooling system. It was mounted at one end of the skid with a floating shaft between it and the gear to allow for a firewall should the unit be enclosed in a building.

Three of these units were built. When assembled and mounted on the skids, they were transported to the station sites by truck. The weather in the Illinois area is somewhat severe in winter. To protect the units the construction of temporary buildings was authorized. These buildings were semi-portable and steel with a firewall separating the engine room from the pump room. While the buildings could be disassembled, moved, and reassembled with ease, they required foundations and were in that sense semi-permanent. The plan included a small office in the building proper and provided some work space in the engine room.

Units as described above have been installed at Marine Station, Saybrook Station, and Whitaker Station, all on the St. Louis-Chicago line in Illinois. In addition an electric unit was installed at Taylorville Station with 250 horsepower at 3550 rpm. These four temporary stations have increased the maximum daily rate from 25,600 to 30,000 barrels per day with no addition of pipe or increase in maximum operating pressures.

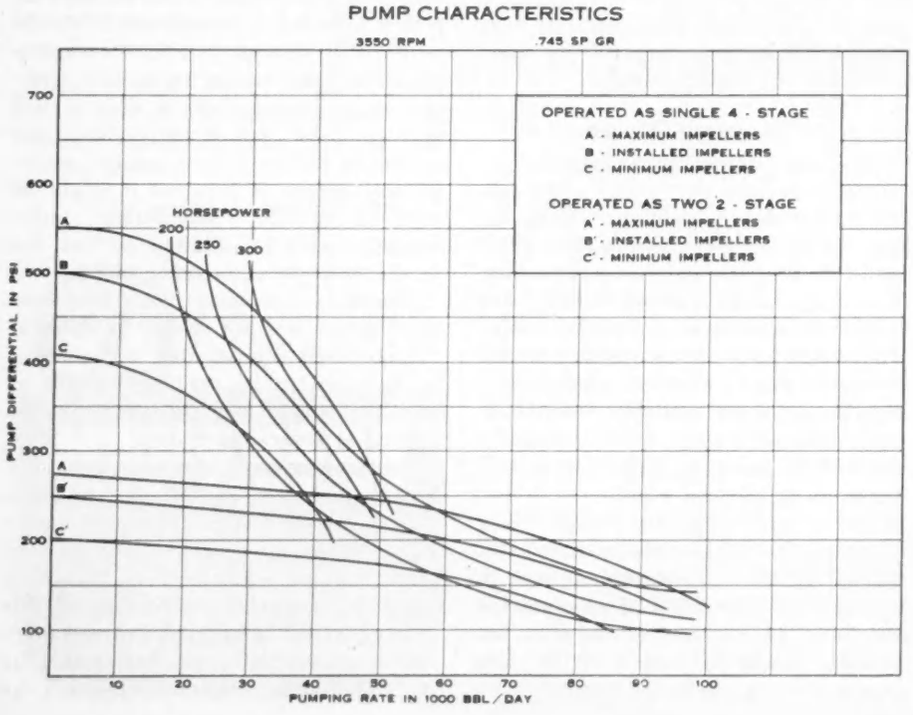
One of the outstanding features of these portable units is the ability of the pump to be adapted to use on any section of the Products Pipe Line System. On the Borger, Texas, to Paola, Kansas, section of the line the maximum sustained pumping rate is about 50,000 barrels per day, with individual days as high as 54,000 barrels per day. In Illinois the rates are more in the vicinity of 25,000 to 30,000 barrels per day. The pumping units are capable of operating satisfactorily on either end of the line by the simple expedient of "splitting stages" for handling the larger quantities. This consists of making two-stage pumps in parallel out of a single four-stage pump. Of course, with the same horsepower available in each case, the increase in quantity handled brings a corresponding decrease in the feet of head put up by the pump.

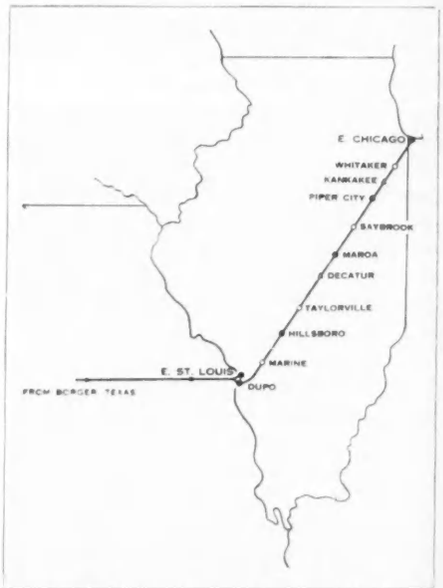
Since the pump is so easily changed from low capacity-high head to high capacity-low head, it is ready for use wherever needed regardless of the variation of pipe line rates due to location. By the proper choice of impellers it was possible to load the 260 horsepower engines at the rate for the Illinois line and, with the same impellers splitting stages, the engine would be loaded at the rate on the Borger-Paola end of the line.

The pumping units now installed on the Illinois section will eventually be available for use at any point on the system. By using the four-stage pump and converting to "split-stage" operation where necessary, the units will be useful anywhere and may be installed in a minimum of time at any location.

About the Author

FRED B. CRANDALL entered Iowa State College in 1940 to study engineering. In 1942 he enlisted in the army, was later commissioned, and served as a first lieutenant with an armored artillery battalion in Germany. He returned to Iowa State on being relieved from active duty in 1946, and received a B.S. degree in Mechanical Engineering in 1947. In January, 1948, he joined the Products Pipe Line Department of Phillips Petroleum Company as an engineer.





Phillips Petroleum Company's products pipe line system, Illinois Section.

• Primary station. Δ Terminal. ° Booster station.

ONLY W.K.M. Valves have a round, full opening passage with the same I. D. as the pipe. This design eliminates turbulence and permits free passage of scrapers.

ONLY W.K.M. Valves seal off completely on both sides every time.

It is significant that most of the World's *big* pipelines are tied together with W.K.M. Valves. The superior performance that led to their use on these jobs will lead you to specify them for your next job when you investigate their exclusive design and operating advantages.

W-K-M Company, Inc.

OIL FIELD, PIPE LINE & INDUSTRIAL EQUIPMENT

HOUSTON, TEXAS, U. S. A.

LOS ANGELES

Cable Address: "WILKOMAC"

Export Office: 30 Rockefeller Plaza, New York, N. Y.

This tool, adaptable to numerous pipe sizes, enables welder's assistant to align pipe ends quickly and accurately while making initial tack welds or stringer.

One-Man Pipe Alignment Device

By GILBERT M. WILSON
Pacific Coast District Editor

NUMEROUS devices and techniques have been devised by pipe-liners to facilitate and speed up aligning and holding of the pipe ends while the welder makes his initial tack welds or stringer bead. Such tools are particularly useful on the many small lease jobs and short pipe lines where small diameter pipe is being laid and where the line is being laid through very rough terrain traversable only with very light equipment.

A handy alignment tool that has been growing in popularity among pipe line crews, one that is easily built in the welding shop, consists principally of a five-foot length of one-inch pipe, one end of which is twisted in such a way that it will wrap in figure S fashion around slightly more than half the circumference of the pipe being handled. Two short half-sections or saddles of pipe, of a diameter equal to that of the pipe line, are positioned so their open sides will face each other, and then are welded to the handle in the manner shown in the accompanying photograph.

As can be seen by the position of the tool, the two shoes are mounted so that they are in alignment with the axis of the handle, the latter, in turn, being parallel to the axis of the line. The rear, upper shoe placed upon the fixed, or already-welded joint, serves as a fulcrum for the tool when the end of the free joint is being lifted up into alignment for welding. The forward, or lower shoe is positioned so that the weld falls in approximately the center of the support. Each shoe is about six inches long, and ordinarily can be made of a piece of pipe of the same diameter as that being laid, if flattened out slightly so that its inside diameter will conform closely the outside diameter of the pipe line. The lower shoe is kept particularly clean and free of dents so that when the free end of the pipe is lifted, it will be in perfect alignment, vertically as well as horizontally, with the end of the fixed joint.

Chain Tiedown

A short length of light chain, one end of which is welded to the pipe handle near the upper end of the device, is used to advantage by the man operating the tool. With the two ends of the pipe aligned for welding, the helper can bear down on the handle, loop the chain under the pipe, and hook a link over a round steel stub welded to the side of the handle. He then is freed of further holding of the pipe ends together and is able to go about other duties while the welder makes the initial welds. The welder, likewise, is assisted by knowing that the device is anchored firmly and that there will be no danger of the pipe ends shifting while he is working. The tool is removed when the joint is securely tacked, enabling the welder to continue on around the under side of the pipe with his stringer and final beads.

The tool can be made to any length or size desired, but the size of the one pictured, with over-all length of between four and five feet, has been found to have about the right dimensions for average pipe line jobs. The shoes can be made of any size pipe, depending upon the diameter or type of line being laid. Generally speaking, however, the tool is best suited for pipe diameters of from two inches up to perhaps six or seven inches, sizes beyond that becoming a bit heavy for the average man to handle in this manner.

The device is easily made and requires little material for its construction. Most difficult part of the fabricating job is the heating and bending of the lower end of the one-inch pipe handle. After the pipe is bent to the required shape, however, it is relatively easy to align and attach the two shoes. The most accurate and easiest method for attaching the shoes consists of clamping them to a joint of the size and type pipe which is to be laid, and spacing them in accordance with the leverage that will be required to enable a man to lift the particular size of pipe. Following this, the curved or twisted end of the handle is positioned on the shoes and welded to them, care being taken that the several parts remain in perfect alignment after the welded parts have cooled. If it is apparent that such a tool will be used on many sizes of pipe and for many jobs, it is recommended that a small jig be fabricated with which the welder can more quickly make the complicated twists in the handle. Several tools thus could be turned out in a very little more time than it takes to make one, and shoes could be cut and welded to the handles only as needed and as pipe line sizes on particular jobs became known.

Radar

In Pipe Line Surveying

A NEW system of aerial surveying with a camera working on the radar principle now permits preliminary surveys of proposed pipe lines to be completed in a fraction of the time formerly required to do this work.

Midwest Aerial Surveys of Tulsa has successfully completed tests of a radar camera which not only provides a continuous picture of the right-of-way but also gives elevations at any point along the line. Using two keyed films, this camera photographs the ground by passing one film over an extremely narrow slot at a speed to coincide with the speed of the plane. The other film is used to photograph a highly sensitive barometric altimeter and the radar instrument which records the plane's height above Terrain (Figure 1). Subtracting the latter reading from the former gives the altitude above sea level at that point.

Original development of this surveying system started approximately 18 months ago when Jack Beindorf, cameraman and pipe line patrol pilot, designed the first successful completely gyroscopically controlled continuous strip camera. Finding the market for the use of this camera was limited, Beindorf teamed up with Charles E. Bush, Jr., who was working on the idea of using radar with ordinary high altitude aerial photography. Experimentation quickly proved that neither instrument operated satisfactorily at high altitudes but either operated at maximum efficiency at approximately 3000 feet.

Pat Combs, of Combs Flying Service, joined the enterprise, lending his plane to further developments.

Designing and building the present camera required three months of tedious work, as every part down to the smallest gear had to be hand made. Meanwhile, the radar equipment was mounted in the plane and calibrated for accuracy. This calibration proved to be a real headache until it was discovered that the dial face of each individual instrument was different. Readings were taken each 25 feet from 100 to 400 feet to provide a curve which would give the required accuracy.

Pipe lines with established profiles were selected for the tests in order to check the accuracy of the instruments against the ground surveys. Surprisingly accurate results were obtained from the start of the tests. The average error was less than eight feet with an occasional erratic error which was found to be caused by a slight de-tuning of the radar, which was eliminated by re-calibration.

At the conclusion of the tests an aerial survey company was formed to provide the service, which will include high altitude pictures for right-of-way location as well as the low altitude continuous picture of the actual right-of-way made with the radar camera. The service will deliver a photo-mosaic at a scale of 1:20,000 showing a three-mile wide strip, a set of stereoscopic prints of the line, and a continuous photograph of the right-of-way keyed to photographs of the instruments. Available, too, will be a film positive which may be projected on a screen.

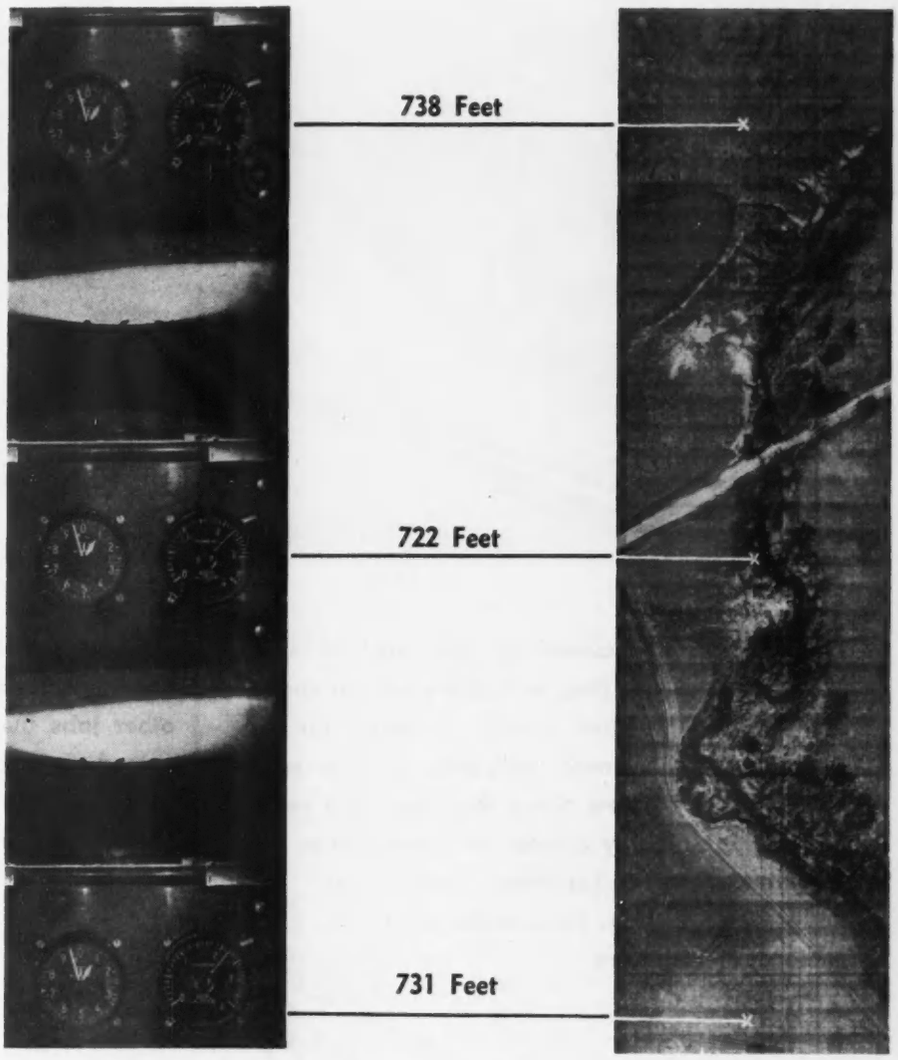
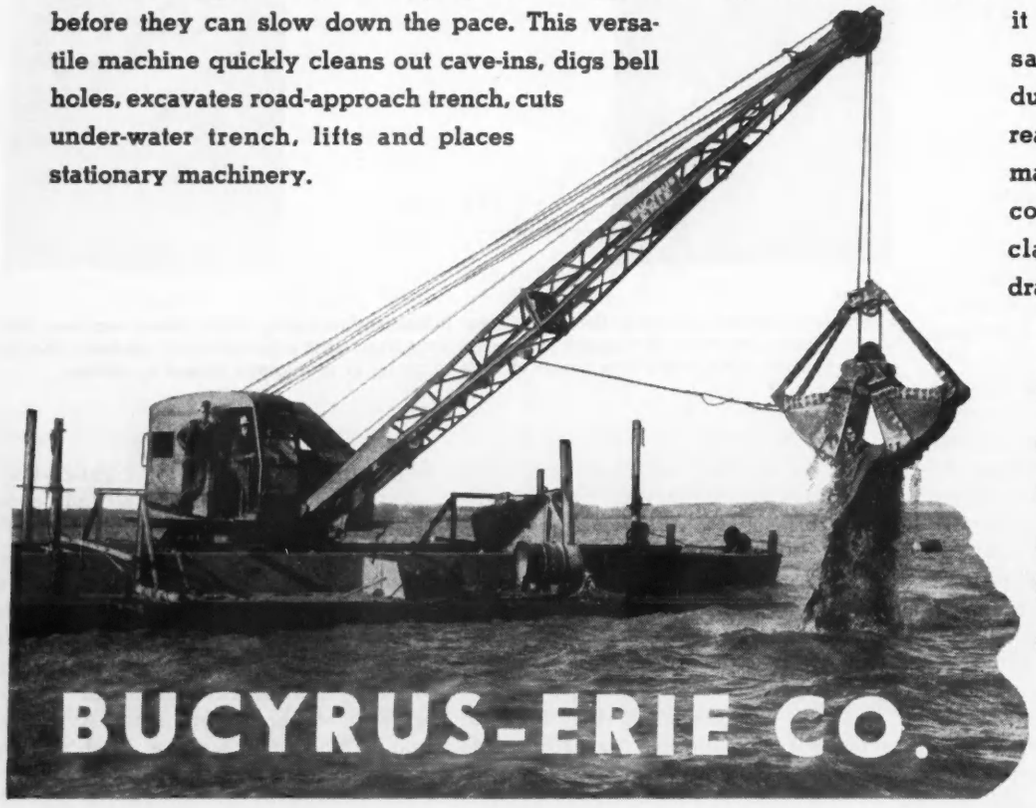


Figure 1. Barometric altimeter (left) and radar instrument recording height above sea level and above terrain. Continuous photograph of pipe line appears at right with instrument readings directly opposite. Line drawn from center of dials to center of photograph locates elevations.

More SPEED for Your Spread

The fast-moving, slick-working Bucyrus-Erie ¾-yd. 22-B excavator can play a decisive role in speeding up your pipe-line spread. It travels up and down the right-of-way, whipping trouble spots before they can slow down the pace. This versatile machine quickly cleans out cave-ins, digs bell holes, excavates road-approach trench, cuts under-water trench, lifts and places stationary machinery.

The 22-B's speedy operating cycle and smooth positive control mean quick handling of these and other jobs that can hold up the progress of the spread. Its mobility and sure-footed stability let it travel about with time-saving ease. Its simple durable construction means real dependability and low maintenance. It is quickly convertible for use as clamshell, crane, shovel, dragline, or dragshovel.



See your Bucyrus-Erie distributor for full details on how you can speed up your pipe-line operations with a 22-B!

BUCYRUS-ERIE CO.

SOUTH MILWAUKEE, WISCONSIN

172E49

FIGURE 1. An installation of pressurized plug valves at a gas metering station, where adoption of the new automatic lubrication would reduce the number of trips required for re-lubrication, netting appreciable savings in man-hours and maintaining contacting surfaces in better condition.

DEVELOPMENT OF A lubricant which may be energized under compression, and thus will feed into the valve for many operations without repressuring, offers promise of vast savings in maintenance and supervision of the millions of such valves, many of which are in remote locations, and involve much time under present frequent lubrication schedules.

DEVELOPMENT of a grease-type lubricant for pressurized plug valves in which has been engineered the ability to absorb energy during compression, and to utilize this stored energy for a gradual, continued feeding of the lubricant from the central storage space to the sliding surfaces, offers a solution of the lubrication problem or at least a marked reduction in the cost of such service.

The reservoir within a plug valve, although containing sufficient lubricant for extended service of the unit, is not normally available unless pressure is applied to the store to force it through the passages in the valve design which carry the lubricant to the contacting areas. Once the pressure, on normal grease, is dropped by the feeding of a small quantity to the bearing surfaces, the body of material in the reservoir is inert, and must be repressured through the lubricant screw. With more than five million plug valves of the pressure-lubricated type in service, users may now be able to reduce servicing and maintenance costs by millions of dollars over the next few years. The secret is in a energizable lubricant which provides fully automatic action in maintaining continuous lubrication to insure instant sealing of leaks.

No lubricant heretofore known has the characteristics for storing within itself energy to be used in distributing its lubricating qualities throughout a valve system over a prolonged period of time. This new, compressible lubricant, christened Hypermatic, allows automatic lubrication to be established in pressurized plug valves.

Lubrication costs of pressurized valves may be cut from 20 to 90 percent and valves will be maintained at a higher peak of efficiency when Hypermatic is used, according to George F. Scherer, director of research of the Nordstrom Valve Division, Rockwell Manufacturing Company, creator of this lubricant. For 20 years, as chief research engineer in the Nordstrom laboratory, he dreamed of eventually compounding a substance that would make valve lubrication automatic. This would eliminate one frequent objection to lubricated valves—the necessity of frequent re-lubrication.

Thousands of man-hours were invested in Nordstrom's Oakland, Calif., laboratory in proving and disproving established lubrication theory and compounding specialized lubricants before the anticipated, self-sealing Hypermatic was born.

Textbooks in physics and hydraulics state that, for all practical purposes, water and oil are incompressible within a confined space. Defying the very physical laws based on this assumption, this lubricant may be actually compressed, thus creating an "energized" condition

which the manufacturer claims will automatically feed lubricant to seal seating surfaces and fill voids in event of a leak. This material retains the energy for an almost limitless number of valve turnings and may be re-energized when the pressure finally subsides by simply adding more of the same substance to refill the valve chambers or by turning the lubricating screw to re-create stored energy.

Hypermatic was primarily perfected to provide automatic lubrication for pressurized plug valves, but indications are that this new product may have applications in other fields. To date, tests have been confined to valves, but later tests may reveal other uses. Field tests now being made on valves have been in progress for months and have proved the success of the energizable lubricant under most conditions in a temperature range up to 250° F. Applications to lines of higher temperature may become available after completion of further tests.

Performance of Hypermatic in a closed reservoir may be compared to the action of a tank of compressed air which, by reason of its compression, has stored within itself sufficient energy to permit intermittent or continuous work to be done as the air is bled off into all types of mechanical devices such as paint spray guns, air motors, hoists, rivet guns, etc. Hypermatic, compressed to a similarly energized condition within a valve chamber, performs the work of renewing the lubricant sealing surfaces.

Works "Like a Door Check"

Another simple analogy is in the action of an automatic door check, in which sufficient energy is impounded within the check when the door is opened to close the door automatically when it is released. Compressing Hypermatic in the valve may be compared to opening the door, while the continuous valve lubrication is analogous to automatic door closing.

Compared to a standard lubricant, which is incompressible and maintains pressure within the valve only for a short time, Hypermatic continues to exert pressure to fill lubrication voids until the confined pressure drops to a minimum of 50 pounds. The time during which the valve maintains 100 percent automatic lubrication without repressurization depends upon the number of valve closures and the amount of lubricant stored within the valve. Full automatic lubrication may be re-stored simply by adding more Hypermatic, either by insertion of the material in stick form or by a high-pressure grease gun.

The self-acting Hypermatic is held in its energized condition between the valve sealing surfaces and the ball check valve in the stem of the valve. Should the valve be neglected over a long period of usage and the energy of the Hypermatic lubricant become dissipated, this material simply reverts to the status of a non-automatic lubricant.

No Capital Investment

The usual concept of automatic lubrication conjures the use of some sort of mechanical contrivance which injects lubricant from an external reservoir into the valve. This type of lubrication injection not only requires a large capital investment, but also is considered impracticable for most valve installations.

So a challenge was set: how could automatic lubrication be achieved without mechanical contrivance operating outside the valve? Thinking inversely, it was decided that if a valve lubricant itself could be self-energized, fully automatic lubrication might become a reality. The seemingly impossible was achieved by creating a plastic lubricant with both compressible and expansible characteristics and combining dynamic properties to maintain an energized status.

The manufacturer claims that the users of pressurized plug valves may derive three distinct advantages from Hypermatic automatic lubrication: (1) Decrease the frequency of valve lubrication; (2) keep the valves in a state of 100 percent lubrication; and (3) maintain the valves in operable condition without first stopping to re-lubricate the valve.

With more than 5 million lubricated valves of the Nordstrom type in service, the savings in man-hours over a ten-year period assume fabulous estimates. Every valve of any design, whether gate, globe or plug, requires regular attention to give best performance. For example, until now, the usual servicing of a Nordstrom valve consisted of inserting a few sticks of lubricant on a schedule consistent with the frequency of turning, type of service, size of valve and line content. Assuming that the average valve of any type requires an average attention of say two hours per year to inspect, check, re-lubricate or service, 10 million man-hours are involved each year for 5 million valves. Translating this to dollars over a period of ten years, there may be assumed an expenditure of $150 million on valve servicing on a basis of $1.50 per hour.

With the availability of an automatic lubricant, frequency of lubrication may be reduced to 1/10, 1/20, 1/50 or 1/100 of previous time. Automatically lubricated valves should require less atten-

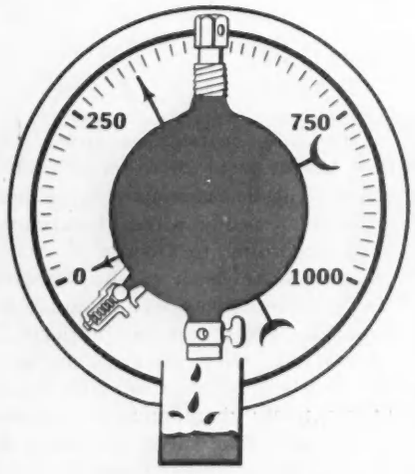


FIGURE 2

NON-AUTOMATIC

For simplification, the lubricant system of a pressurized plug valve can be compared to a closed spherical chamber with a "jacking screw" at the top. This screw on the sphere may be compared to the lubricant screw of the valve while the drain under the sphere acts in effect like consumption of lubricant within the valve.

Assume this sphere holds exactly ten cubic inches and that ten lubricant sticks, each one cubic inch, are inserted. Since non-automatic lubricant is incompressible, the sphere can only hold ten cubic inches. Apply a screw and it is pressurized to, say, 350 pounds or more. Bleed even an infinitesimal amount of lubricant through the drain and pressure drops rapidly. Therefore, the lubricant will not "feed" or push forward until the top screw is again turned to repressurize the lubricant.

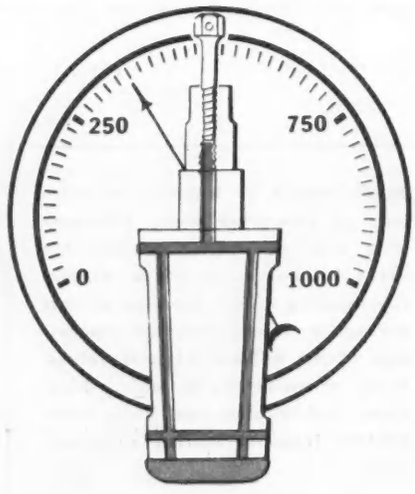


FIGURE 3

AUTOMATIC

Assume this plug within a pressurized valve of the Nordstrom type also holds exactly ten cubic inches of lubricant and is filled with ten sticks of Hypermatic, each one cubic inch. Being compressible, additional Hypermatic can be added, at least to a total of 15 cubic inches within a ten-cubic-inch storage space. Tightening down of the lubricant screw energizes the lubricant to any pressure, but for purpose of illustration, let's build the pressure to 350 pounds. The pressure remains at 350 pounds until the valve plug is operated many times. As the lubricant is gradually consumed, the pressure will slowly drop but not abruptly, as is the case of non-compressible lubricant. The lubricant will continue to feed and fill any void or source of leakage within the valve as long as there is any pressure beyond 50 pounds. Turning of the screw re-energizes the lubricant.

Diagrams illustrate the principle and application of non-automatic and automatic valve lubricant.

tion, less inspection, and only a fraction of their previous servicing. A conservative estimate of savings in man-hours of line service, if predicated on a saving of 50 percent, would total $75 million in ten years.

Valves are expected to consume less lubricant because Hypermatic should maintain a better equilibrium of pressure, avoiding over-lubrication by inexperienced attendants. Valve life expectancy may also be extended, which should reflect additional savings.

Energized Feature

Basically, Hypermatic is similar to standard, non-compressible materials in its lubricating properties and wetting action. It is available in stick or bulk, just as are standard valve lubricants. The main difference between this automatic lubricant and non-automatic types is its intrapowered action under working conditions. Hypermatic flows into voids and maintains an unbroken film surface. When it comes to rest, as when the valve turning is complete or any void is filled, it again assumes its plastic form with all lubricated surfaces perfectly sealed.

The performance could be duplicated to some extent with standard, non-compressible lubricant, provided the lubricant screw was turned or some other physical means was used to keep pressure on the lubricant while the valve was being turned. Since Hypermatic is self-energized, this complete lubrication is entirely automatic through a large number of valve closures.

Due to its inherent nature, a greater volume of Hypermatic may be added to the valve storage reservoir than a standard lubricant. Unlike the reaction of standard non-automatic lubricants, pressure within the valve is built up as Hypermatic absorbs energy. It impounds power likened to billions of pentup springs compressed with power, each spring ready to push lubricant forward into any void that may occur.

It might be asked, "Will Hypermatic feed into the line since it is continually under pressure?" Or, "Does the lubricant pressure have to be high or higher than the line pressure?" The answer to both questions is "no." The physical properties of Hypermatic are such that they permit easy flow through the provided lubricant channels, but when spread out in a thin sealing film between the valve seating surfaces, the lubricant resists replacement. Hypermatic continues to replenish lubricant to the sealing surfaces even when the lubricant pressure falls far below the line pressure. For example, if a leak of line fluid inside the valve were to develop, a pressure gradient along the path of leakage would exist with the downstream exit pressure being substantially below the upstream pressure. This being the case, the lubricant pressure required to inject the lubricant into the path of the leakage would be approximately equal to the static pressure of the leakage stream at any point. Downstream, when the pressure is zero, it is evident that the lubricant pressure required to seal off the leak at this point would have to be only slightly higher than zero. For this reason, Hypermatic stops leaks automatically, demonstrating its effectiveness in increasing valve efficiency.

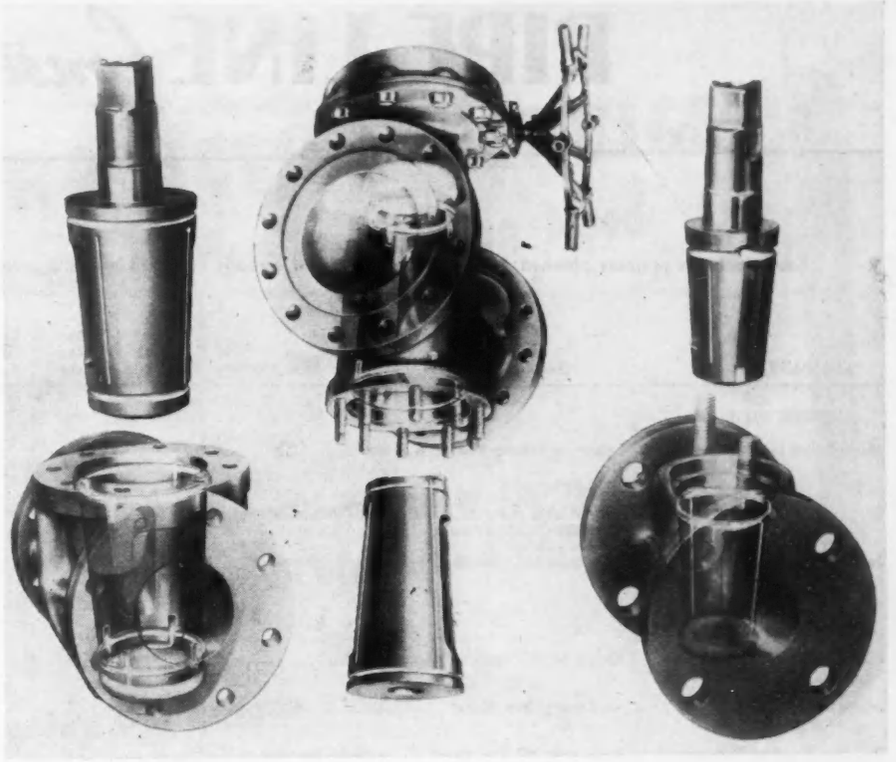


FIGURE 4. Three types of pressurized plug valves adaptable to Hypermatic automatic lubricant, shown with cover plates omitted. Plugs show groove arrangements which connect with companion grooves in their respective bodies to form an unbroken circuit. By turning a lubricant screw inserted in top of plug, hydraulic pressure energizes Hypermatic lubricant and stores energy within the valve's reservoir for future use.

George F. Scherer, research director of Nordstrom Valve Division, is shown inserting stick of Hypermatic lubricant into plug valve. By use of gauge with hollow stem he demonstrates pressure of lubricant, and by scraping groove on the plug through one of ports will demonstrate instant filling action of Hypermatic lubricant.

Applicable To All Nordstrom Valves

Hypermatic lubricant may be used in all valves of the Nordstrom type to secure the benefits of automatic lubrication. Only the normal valve adjustments need be made to hold energized lubricant. It is unnecessary to purge the lubricant from valves already in use. The old lubricant is gradually forced out over a period of time. Automatic lubrication is effective over the entire range of pressures that are recommended, including vacuum service.

A descriptive bulletin containing information on "Hypermatic," the new energized lubricant developed for pressurized plug valves, together with a folder containing answers to 50 typical questions of maintenance men is available by writing to the Nordstrom Valve division, Rockwell Manufacturing Company, 400 North Lexington Avenue, Pittsburgh 8, Penn.

PIPE LINE *Construction*

Table includes projects planned, contracts awarded, and spreads or entire projects completed since the last issue of WORLD OIL

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels Cu. Ft.)	REMARKS
CRUDE OIL LINES					
Atlantic Pipe Line Company	Refugio to Aransas Pass, S. W. Texas	30	10	.....	Started in August by Shanks & Eustace, Alice, Tex., who subcontracted from Evans-James Constr. Co., Little Rock.
Continental Pipe Line Company	Little Wichita River sta., Archer Co. to Company's refinery, Wichita Co., N. Texas	25	6	.....	Work started in August on take-up of old 4-in. carrier that this line will replace.
Interprovincial Pipe Line Co., Ltd.	Edmonton, Alta. Canada to Lake Superior, Wisconsin	1150	16–18–20	95,000	Plans have been announced for extending this line to the Great Lakes. It was originally proposed to build only to Regina, Can. Completion to Regina to be made by Fall, 1950 and to the Lake by Spring, 1951. Cost would be $90 million.
Iraq Petroleum Company, Ltd.	Kirkuk fld. to Tripoli, Lebanon	530	16	.....	Completed on capacity of 40,000 bbls. per day. By end of year additional pump stations will give 90,000 cap.
Magnolia Pipe Line Company	Lea County, New Mexico	13	8	.....	C. L. Rogers Constr. Co., Inc., Wichita Falls, completed this job in late August.
Republic Pipe Line Company	Susan Peak fld, Tom Green Co. to Shell's line west of Eldorado, W. Texas	40	4	2,500	Sheppard-Geiger Constr. Co., Corpus Chirsti, has work underway.
Shell Pipe Line Corporation	Elk City fld, Beckham Co. to Ozark System, Cushing, Okla.	160	10	24,000	Pipe will come from take-up of 190-mile Cushing-Emmitt, Mo. line Trojan Constr. Co., Inc., Oklahoma City, started take-up in August and lay in September. To be completed in December.
Socony-Vacuum Oil Co., Inc.	Gooseberry fld, Park Co. to Ohio's sta., Hot Springs Co., Wyoming	13½	4	.....	Completed September 15 by Pacific Pipe Line & Engineers, Ltd., San Francisco.
Stanolind Pipe Line Company	Lea County, New Mexico	10	4 & 6	.....	Completed September 10 by C. L. Rogers Constr. Co., Inc.
Sunray Oil Corporation	South Palacine fld. to Sunray's Velma sta., Stephens Co., Oklahoma	6	4	.....	This line completed in August will deliver hi-gravity crude to Sunray's catalytic cracking refinery at Duncan.
PRODUCT LINES					
The Buckeye Pipe Line Company	Speedway City, Ind. to Lima, Ohio	140	8	.....	Construction began September 6 by H. L. Gentry Constr. Co., Jackson, Michigan.
Great Lakes Pipe Line Company	Tulsa to Minneapolis Kansas City, Mo. to Omaha, Nebraska	931	12	.....	Great Lakes recently announced this $37½ million expansion program. Initial work is to be on Des Moines-Minneapolis leg and is to be completed by December 15. Meanwhile, the Des Moines-Tulsa and Cushing-Tulsa sections will be started. Delivery of 12-in. pipe for Kansas City-Omaha section will be made 1st qtr. 1950.
	Cushing to Tulsa, Oklahome	45	8	.....	
Salt Lake Pipe Line Company	Salt Lake City to Burley, Idaho Burley to Boise, Idaho	169 151	8 8	....	Smith Contracting Corp., Ft. Worth, started August 20. Oklahoma Contracting Co., Dallas & Grafe-Callahan Constr. Co., Los Angeles, jointly, began this work August 25.
NATURAL GAS LINES					
Arkansas-Louisiana Gas Company	Waskom fld, E. Texas to Columbia Co., Arkansas Columbia Co. to Perla, Arkansas	72 91	20 20	200 mln. 140 mln.	Anderson Bros. Corp., Houston, started in late August. Latex Constr. Co., Houston, started construction Sept. 7
Atlantic Gulf Gas Company	Eastern Louisiana to Georgetown, S.C. with branch from Albany, Ga. to Jacksonville, Fla.	1731	?–26	384 mln.	This United Gas Corp. subsidary has made an amended application to FPC. Original was for 1530 miles from Hattiesburg, Miss. to S. C. and Fla. Estimated cost is $92 million.
Central Hudson Gas & Electric Corporation	Home Gas' line at Tuxedo to Company's gas mfg. plant, Poughkeepsie, N. Y.	40	?	.....	Application has been made to FPC for this $1.7 mln project.
Cities Service Gas Company	Hugoton fld, Kansas, gathering system	26	4–6–12	.....	Construction completed in August by Knupp Constr. Co., Inc.
Colorado Interstate Gas Company	Loop near Lakin, Kans., Hugoton fld., & river crossing	16	20	.....	R. H. Fulton & Co., Lubbock, Texas has contract.
Consolidated Gas Utilities Corp.	Elk City fld, to Company's sta, Carpenter, Okla.	14	12	.....	To provide gas outlet for fld. Shell will build gathering system. To be built by end of 1949.
Dayton Power & Light Company	Dayton, Ohio, vicinity	14	12–16–18	.....	Started Sept. 6 by Poston Constr. Corp., Barberton, Ohio.
Dirreccion General del Gas del Estado	Plaza Huincal flds. to General Conesa, Argentina	374	8	.....	Line will connect with 1100-mile 10-in. Comodoro Rivadavia-Buenos Aires line. Bids opened in September.
Dow Chemical Company	Beaver Creek fld, Crawford Co. to Loomis, Michigan	56	8	.....	Somerville Constr. Co., Ada, Mich. has job underway.
Eastern Natural Gas Company	Standardsville, to Norfolk, Va. area	165	?	.....	Application made to FPC and has been consolidated with 4 others that would serve essentially same area.
Grand River Gas Transmission Company	TGT line at Meadville, Pa. to Austinburg, Ohio	42	?	.....	Applied to FPC for permit. Two projects now pending. Erie Gas Service Co., Inc. & Lake Shore P. L. Co. would serve same area and also obtain supply from TGT's Kentucky-Buffalo line at Meadville.
	Austinburg to Fairport, Ohio	22	?	.....	
	Austinburg to Ashtabula, Ohio	10	?	.....	
Lavaca Pipe Line Company	Vicinity Port Lavaca, Calhoun Co., S. W. Texas	30	8 & 10	.....	Being constructed by Brown & Root, Inc., Houston.
Michigan Consolidated Gas Co.	Ann Arbor to Milford, Michigan	22	12	.....	Started September 15 by Somerville Constr. Co.

Barrett

PROTECTION SERVICE

Covers Every Pipe-coating Need

Materials and Application Procedure for:

1. Water Industries
2. Natural Gas, Crude Oils and Products Transmission
3. Professional Application in Plants and Yards
4. Distribution Systems
5. Reconditioning Operations
6. Gathering Systems
7. Recycling Operations

Materials and Application Procedure for

RECONDITIONING OPERATIONS

It has been established that the cost of reconditioning an uncoated or poorly coated pipe greatly exceeds the cost of a good initial installation.

However, when replacement is not necessary or feasible, other measures may be used to restore the line to operating condition.

If the pipe is not too badly pitted, spot welding can restore the original wall thickness. In other cases, a half-sole is recommended. Cleaning, re-priming, re-coating and re-wrapping can be counted on to extend the usefulness of the line.

Barrett can furnish coating materials for every kind of reconditioning job. If you have any trouble spots in your pipelines, call on us for help. Our long experience is at your service.

Barrett can furnish coating materials for every kind of reconditioning job.

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Barrett*

*Reg. U.S. Pat. Off.

Pipe Line Construction (Continued)

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels Cu. Ft.)	REMARKS
Nebraska City Utilities	Otoe to Nebraska City, Nebraska	23½	4	.....	Started August 20 by D. J. Hines, Hays, Kansas.
Northeastern Gas Transmission Company	Greenwich, Conn. to New England states	511	?-20	350 mln	This newly formed firm has made application to FPC for line to serve 6 New England states at a cost of $171½ million. Gas would be supplied by Transcontinental at Greenwich, Conn. and at various points in Mass. by TGT's proposed Buffalo-Mass line. System would be completed in late 1950.
Northern Natural Gas Company	Hugoton fld, Kansas, gathering system	46	4-6-8	.....	Started August 20 by Knupp Constr. Co., Inc. will complete October 1.
	Oakland to Atlantic, Iowa	17½	24	.....	Texas-Minnesota line loop completed September 20 by Eastern Constr. Co., Inc., Dallas.
The Ohio Fuel Gas Company	Pavonia sta. to Weaver sta., Richland Co., Ohio	11	16	.....	Started in September by H. L. Gentry Company.
Phillips Petroleum Company	Hansford, Tex. Panhandle, gathering system	14	24	.....	Underway August 16 by Vaughn & Taylor Constr. Co Wichita Falls.
Private Interests	Niigata area flds. to Tokyo, Japan	250	10	.....	This proposed line would be the first gas line in Japan.
Shell Pipe Line Corporation	Sheridan fld, Colorado Co., U. Texas Coast	21	3 & 4	.....	Job started in late August by C. W. Sternberg, Houston.
Southern Natural Gas Company	Loop on Montgomery, Ala., branch Loop on Meridian, Miss., branch Extension of Alabama branch	31¾0 6⅝0 7½0	....	11 mln. 1 mln.	FPC permit granted. Montgomery loop includes Warrior & Chattahoochee River crossings. The extension will run to Southern Cement Plant, Shelby Co., Ala.
Texas Gas Transmission Corp.	Carthage, E. Texas to Lisbon, Louisiana	103	20	.....	This section of the Texas-Ohio line was started in August by N. A. Saigh Co., Inc., San Antonio. Also started by same firm was a Miss. River crossing near Greenville, Miss.
United Gas Pipe Line Company	S. E. Louisiana flds. to Atlantic Gulf Gas Co's proposed La.-S. C.-Fla. line in eastern Louisiana	224	.....	384 mln.	This line would supply entire requirements of the new line planned by Atlantic Gulf Gas Co. which is also a subsidiary of United Gas.
	DeSoto Parish to near Monroe, Ouachita Parish, Louisiana	105⅝0	20	.....	Application to FPC for this loop on Carthage-Sterlington (La.) line. Designed to increase delivery to Miss. River Fuel to 195 mln.
	Pettus-Burnell area flds. to Converse, So. Central Texas Loop around San Antonio, Texas Loop around Austin, Texas	72 19 12	20 16 12	140 mln.	Brown & Root, Inc. has started construction of the Austin loop and also has clearing work on the transmission line underway.
	New Orleans Vicinity	25	16	.....	Will be laid by H. C. Price Co., Bartlesville, Okla.

977

YEARS OF EXPERIENCE

The 66 employees of Latex Construction Company participating in our Employees' Retirement Plan during 1948 (eligibility requirement: 5 years or more continuous employment) have a combined total of 977 years of pipeline construction work. These years of experience and specialization are reflected in the efficiency of Latex pipeline construction.

LATEX CONSTRUCTION COMPANY

General Contractors

OIL — GAS — GASOLINE — WATER PIPE LINES

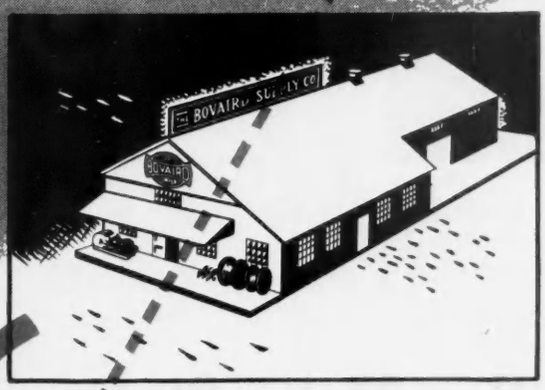
HOUSTON, TEXAS ORGANIZED 1936 ATLANTA, GEORGIA

Laurence H. Favrot Geo. A. Peterkin J. W. Sharman R. P. Gregory

3 Reasons WHY YOU'LL GET A BETTER "Buy From Bovaird"

Stocks

1. STOCKS for your every drilling, producing, pipe line or refining need are available through Bovaird Stores. Whether it's a complete drilling rig, a pumping unit, or a replacement of the smallest item, you can depend on anything you "Buy From Bovaird."



Stores

2. STORES and offices are strategically located in many active oil field areas—each one ready to expedite delivery of your supplies when and where you need them.

Service

3. SERVICE to the oil man is a Bovaird by-word. Bovaird Representatives are well informed on the latest equipment and field conditions and ready to give you the fast action you need to solve your supply problems.

OFFICES AND STORES

ILLINOIS—Clay City, Grayville, Salem
KANSAS—Chase, McPherson, Pratt, Russell, Wichita
OKLAHOMA—Duncan, Oklahoma City, Pauls Valley, Sapulpa, Seminole
TEXAS—Borger, Dallas, Odessa, Pampa

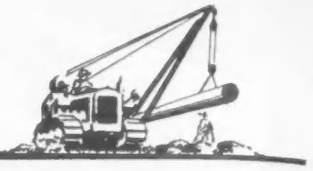
SUPPLY BOVAIRD COMPANY

THE BOVAIRD SUPPLY CO.

GENERAL OFFICES: TULSA, OKLAHOMA

How to do it!

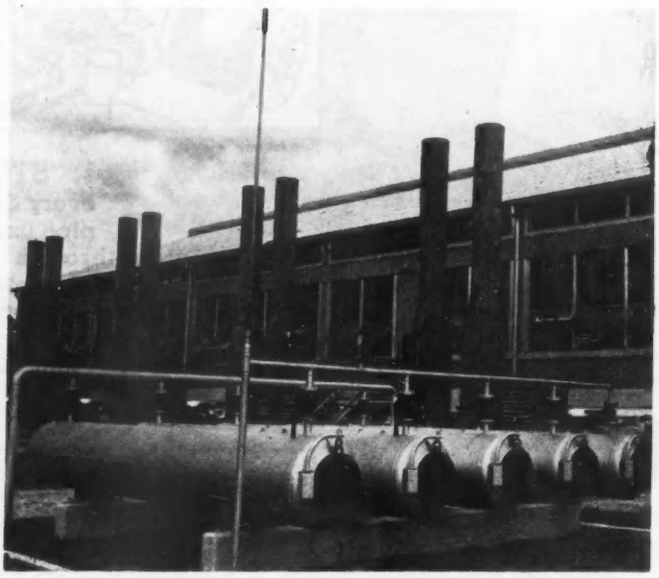
PIPE LINE HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

HOW TO—Handle Starting Engine Compressed Air

Large gas or diesel engines are commonly started with compressed air that must be supplied in adequate volumes and at sufficient pressures to turn the engine over. One air compressor can be used for this purpose if adequate storage is provided for the air required.



Five high-pressure horizontal tanks were especially designed to serve this purpose. They were mounted on two long concrete foundations as shown. Each end of the tank rests in a saddle welded to a vertical piece of metal plate that is flanged at the bottom and bolted to the concrete foundation. This type of support permits expansion and contraction of the tanks.

Compressed air is supplied at the far end through a three-inch header that crosses over the top of all tanks. Discharge of the air to the engine starting air manifold is at the near end through a two-inch line that also is connected to the tanks at the top. This connection prevents any condensed moisture from entering the engines.

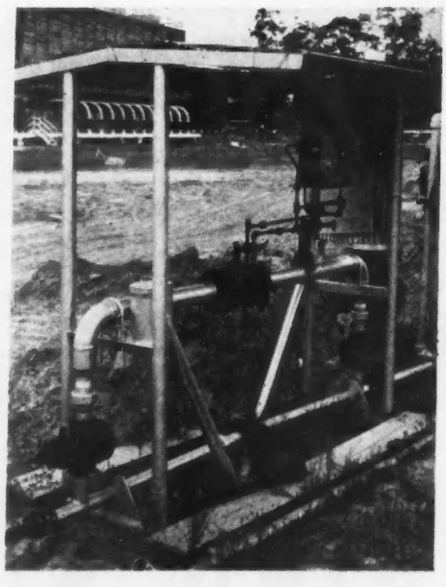
A safety feature has been incorporated in the air discharge line. At the tee where the horizontal header terminates and the vertical riser is connected, a reducer is used and a one-inch line is added so that it extends about 14 feet from the ground. A steam whistle was mounted to the top of this line. A pressure relief valve was inserted in the line at the point of size reduction so that when the pressure in the vessels exceeded 250 pounds per square inch, the valve would open and blow the whistle, notifying the operator that the vessels had been overloaded.

HOW TO—Fabricate Portable Gas Meter Station

To measure gas supplied for construction purposes near one booster station, a simplified portable meter station was erected. A 2½-inch line connects into a four-inch riser to supply the required gas. The flow line, also a 2½-inch line, ties into each side of the portable meter station by unions as shown.

The unit is made from salvaged tubular material, and is merely a framework mounted on a pipe skid. Overall dimensions are 6 feet high; 4 feet wide; and about 10 feet long. Ends of the skid runners are bent upward to facilitate dragging over the ground. The four upright corner posts are braced by two diagonal sections welded to a diagonal brace in the skid. Only two uprights need be braced since they are tied together by the angle-iron supports.

The meter run is supported by angle iron cross pieces placed about 30 inches from the skid frame. The line increases in size to three inches and is secured by U-bolts at each end. The meter run is connected to the riser sections at each end by unions which permit the interchange with other size pipe if the need arises. A bypass line continues straight through the skid and is equipped with a valve so that in the event a new orifice plate must be put in the line, the meter run could be closed off and the flow of gas controlled manually.



Extra orifice plates are stored in oil in a container made from a short section of casing and welded to the near end of the unit. Part of the far end of the station is covered with sheet metal to serve as protection to the meter as well as to the supply of charts and ink which are stored in a sheet metal cabinet. The metal roof protects all parts of the meter from both sun and rain.

AN *energizable* LUBRICANT

to seal Nordstrom valves automatically and continuously

Fully automatic lubrication for Nordstrom valves is here! Introduction of Rockwell *Hypermatic* lubricant marks the greatest advancement in the valve industry since the invention of Nordstrom valves 30 years ago. Hypermatic is the first and only genuine automatic lubricant.

Now you can make deep cuts in your valve maintenance cost because your lubrication crew need devote only 1/10, 1/20, 1/50, up to 1/100 as much time to re-lubrication.

Your Nordstrom valves will give better service with less cost because each one will be automatically maintained in a condition of 100% lubrication, even in event of considerable neglect.

Leakage will be prevented because Hypermatic both seals and lubricates with split-second action and positive certainty.

Unlike any other lubricant, Hypermatic is compressible and expansible. Self-powered energy is created within the lubricant merely by turning the lubricant screw or using a grease gun. This energy then serves as a powerful force-feed. Almost twice as much Hypermatic can be compressed into the valve's lubricant chambers. The pressure is retained, not for days, but for months, if the valve is not operated. If frequently operated, Hypermatic will retain its pressure for scores of turns longer than if non-automatic lubricant is used.

NOTHING TO BUY EXCEPT THE LUBRICANT

Instead of resorting to the use of extraneous devices or endeavoring to use variable line pressure, Hypermatic provides a new system of lubrication which gives the effect of a vastly improved valve design. You don't have to invest a single cent in mechanical devices. You don't even have to purge the old lubricant. Simply switch to Hypermatic and apply it to your present Nordstrom valves. It will displace the old lubricant.

Your Nordstrom valves will use less Hypermatic than non-automatic lubricant because Hypermatic creates, by its flexible nature, a "spring-action" which to a great extent prevents over-lubrication and under-lubrication.

IT COMPRESSES

Like the action of a door-check, Hypermatic compresses to a fraction of its volume when the lubricant is forced in. This stores up energy for future use.

ROCKWELL **Hypermatic** TRADE MARK **LUBRICANT**

PATENT APPLIED FOR

IT EXPANDS

When the valve needs lubricant to seal a leak, its inherent energy forces it to expand and seal the valve seat. It feeds into any void instantly.

FOR NORDSTROM VALVES

LUBRICATION

MAN-HOURS SAVED · TWICE THE STORAGE · MULTIPLIED VALVE LIFE · GALLING ELIMINATED · SAVES LUBRICANT

***Switch* to Hypermatic—stocks now available.**

Place your order immediately for this new, amazing automatic lubricant. A variety of types is available to meet approximately 75 per cent of Nordstrom valve services. Field demonstrations are now being arranged.

NORDSTROM VALVE DIVISION—*ROCKWELL MANUFACTURING CO.*

400 North Lexington Avenue • Pittsburgh 8, Pennsylvania

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses

Export: Rockwell International Corp., 7701 Empire State Building, New York 1, New York

Mail this coupon for HYPERMATIC Bulletin

NORDSTROM VALVE DIVISION, Dept. 18
Rockwell Manufacturing Co.
400 North Lexington Ave., Pittsburgh 8, Pa.
Send Hypermatic Bulletin and Specifications

Name_____

Address_____ Zone____ State____

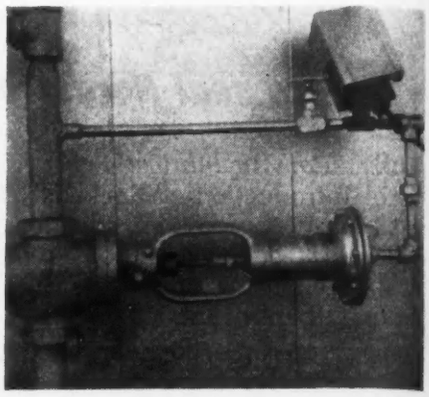
City_____

Company_____

HOW TO—
Guard Compressors

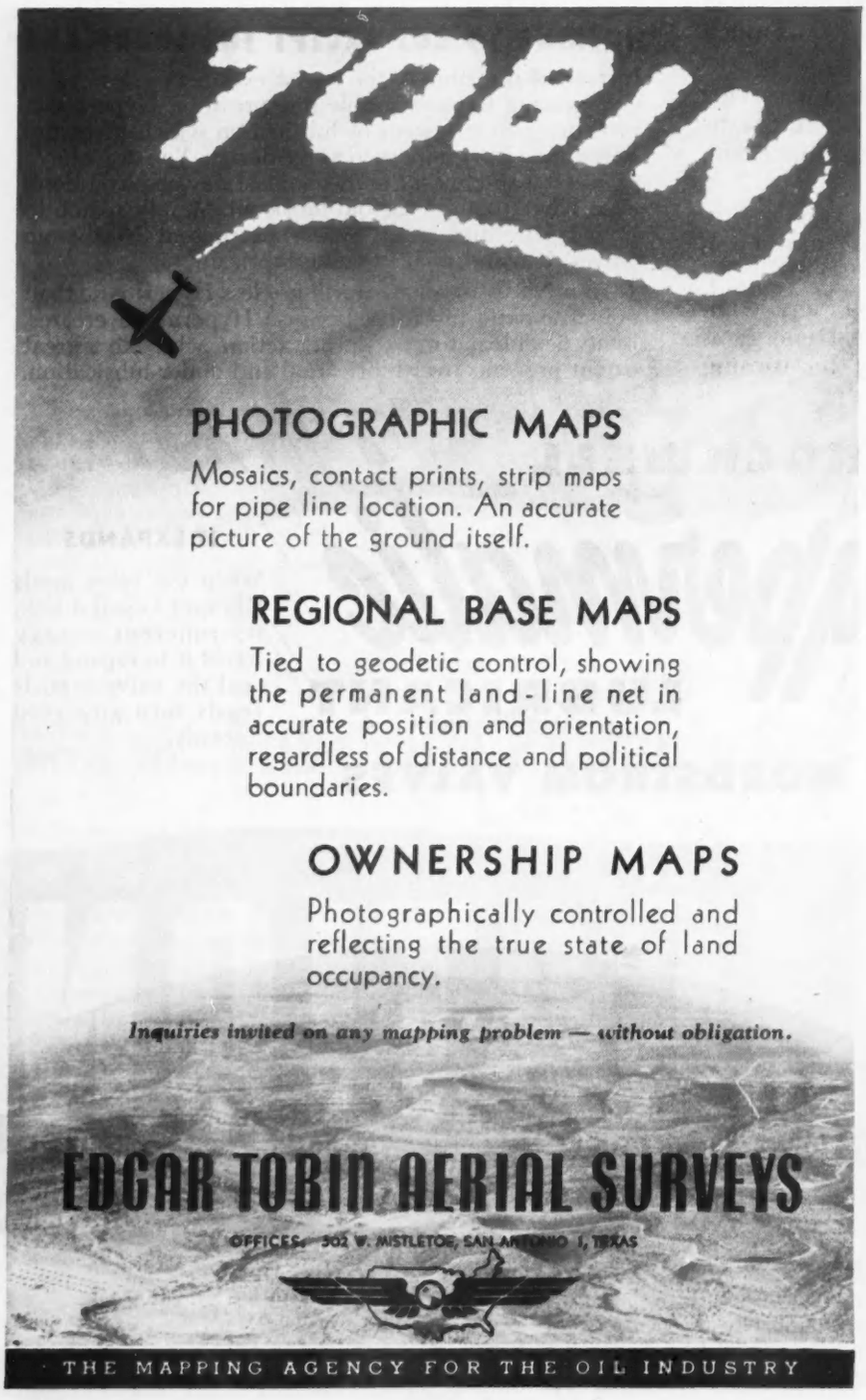
When liquids are in the incoming gas at compressor stations, it is very important to keep the level in the scrubbers low enough to prevent the liquids from carrying over into the suction lines. A simple method illustrated is to connect a mercury switch to a float on the scrubber. After making connection to the lighting circuit, the lines are carried to a solenoid valve on a diaphragm valve. This diaphragm valve is placed in the main fuel line leading to the compressors.

Directly down stream from the solenoid valve, between the valve and the diaphragm, a tee with a 1/64-inch hole is installed. This allows no pressure to be carried on the diaphragm with the solenoid valve closed, therefore the main



two-inch regulator valve ordinarily stands open.

When fluid rises to a predetermined height in the scrubber, the mercury switch closes the circuit and the solenoid valve opens and shuts off the fuel supply to the compressor engines. As soon as the fluid is lowered, the solenoid valve closes and the pressure is bled through the 64th-inch hole and the main two-inch valve opens.


TOBIN
PHOTOGRAPHIC MAPS
Mosaics, contact prints, strip maps for pipe line location. An accurate picture of the ground itself.
REGIONAL BASE MAPS
Tied to geodetic control, showing the permanent land-line net in accurate position and orientation, regardless of distance and political boundaries.
OWNERSHIP MAPS
Photographically controlled and reflecting the true state of land occupancy.
Inquiries invited on any mapping problem — without obligation.
EDGAR TOBIN AERIAL SURVEYS
OFFICES: 502 W. MISTLETOE, SAN ANTONIO 1, TEXAS
THE MAPPING AGENCY FOR THE OIL INDUSTRY

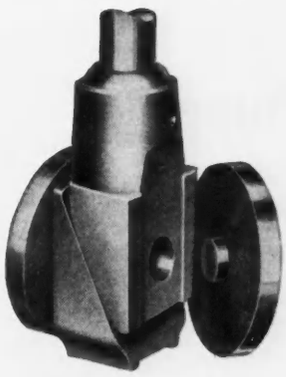
HOW TO—
Make Light Ladder

It is sometimes impractical to install pressure control, or other instruments near the ground where men can easily adjust, maintain or inspect them for operating conditions. When it is necessary to place the control instrument on pipe lines high above the ground level, some sort of ladder or stairway is required. Wood ladders obviously contribute to fire hazards as they are readily combustible, while the ordinary steel ladder is heavy and cumbersome, frequently requiring two men to raise and place it in position for use.

A ladder, sturdy and simple in design can be made easily from concrete reinforcing bars or sucker rods. Four pieces of straight material are obtained for the four legs; the completed unit is of box-type construction. Two legs are cut to the length required for raising it to the height of the instruments to be inspected. These legs are for the front

How Darling features prevent trouble and expense

UNIFORM WEAR DISTRIBUTION



A LARGE percentage of valve leaks, lost time, expense, can be blamed on uneven wear—the uneven wear caused by repeatedly exposing the same disc and seat areas to concentrated pressure, fluid flow, and resultant galling from operation.

For years such leaks were considered the result of normal, expected wear. But the unique design of Darling Double Disc Parallel Seat Gate Valves has proved that uneven wear can be prevented. The two valve discs shown in the cutaway view, and again in the removed inside assembly, are separately and independently hung and free to revolve through their 360°. Valve operation aids the action during the lowering and raising of the disc assembly. The discs never seat twice in the same position and obviously wear is bound to be uniform. This results in tight closure even when the disc faces are worn.

Hundreds of Darling gate valve users have learned by experience that uniform wear distribution results in longer service life and correspondingly lower maintenance cost.

DARLING VALVE & MANUFACTURING CO.
Williamsport 7, Pa.

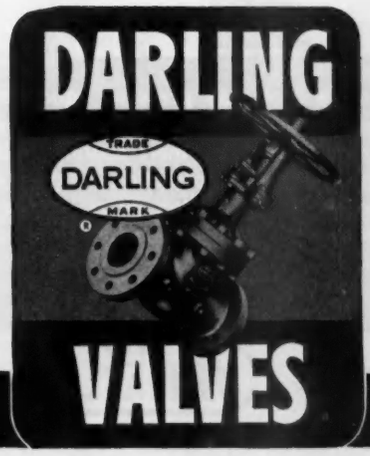
"This advertisement is one of a series showing how the unique Darling Fully Revolving Double Disc Parallel Seat Gate Valves answer the following critical operating problems:

- Positive, easy closing—regardless.
- Automatic adjustment for valve body distortion.
- Elimination of disc-to-seat friction and galling.
- Uniform wear distribution.
- Extreme simplicity.
- Greater service life.
- Simplified maintenance.

CORROSION RESISTANT VALVES

In addition to conventional iron, bronze and steel constructions, Darling specializes in valves for any corrosive fluid: iron body valves with special alloy trim; iron body, rubber lined, with special alloy trim; all bronze; and all special alloy. Darling's 50 years of experience in meeting unusual requirements is always at your service.

Outline your service requirements and get complete *information on Darling Valves of the proper type. Or, send for the complete 300-page Darling Catalog No. 17M. It describes Darling Valves of* all *types for* every *normal or unusual service, and for pressures up to 1500 pounds. It's full of helpful information... Yours for the asking.*



THE VALVE MARK OF QUALITY . . . WATCH FOR IT

panel and contain hooks, if moved frequently from one point to another, or eyelets for fastening to brackets attached to the pipe line above the engine room outside walkway. The back two legs are bent at an angle of about 40 degrees near the top so the ends may be welded to the front legs. Rungs are placed at desired spacing for easy climbing, and connecting links are welded at frequent intervals to provide the desired stiffness of the ladder.

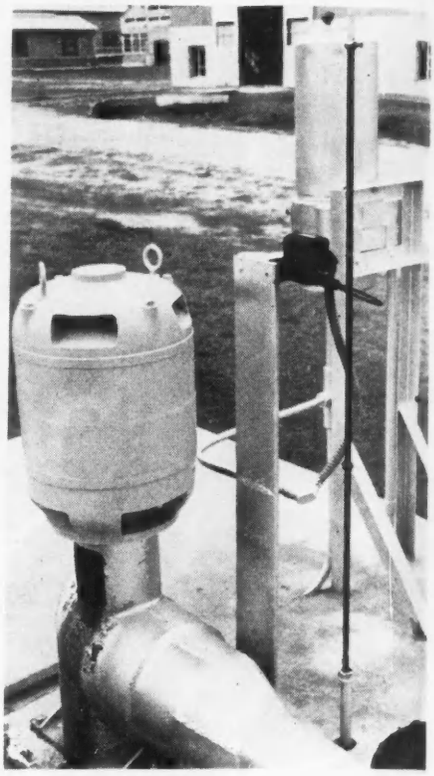
HOW TO—
Control Sump Pump

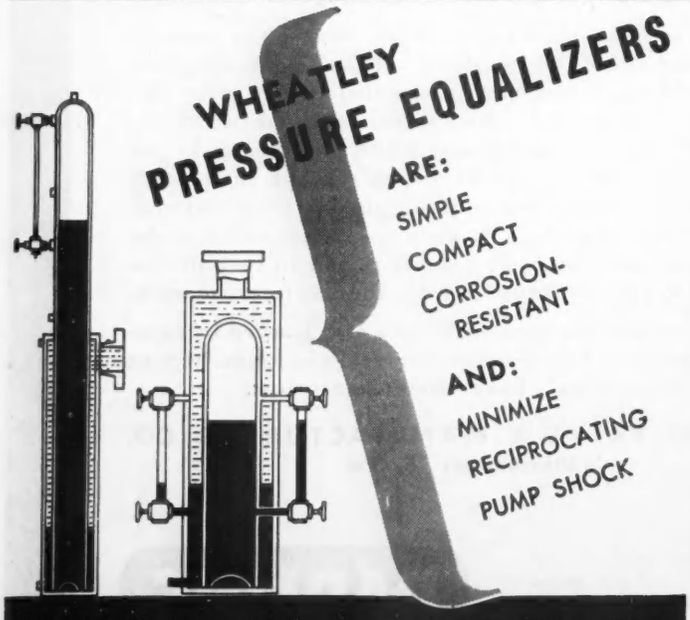
Waste water from this booster station was gathered in one central concrete sump for disposal into nearby storm ditches. Water which accumulated in the large concrete sump came from small drainage ditches around the station and from drains located at strategic points throughout the plant. The centrifugal pump which handled the water after it came into the sump was controlled by the level in the sump.

The electric motor which powered the centrifugal pump was controlled by a magnetic switch energized by a small capacity contact switch. This contact switch, shown in black, was mounted on the same structural steel stand which supports the larger and heavy-duty magnetic switch. Electrical connections between the two switches are totally enclosed.

The small contact switch is operated by two limit stops which are clamped to a vertical rod. This rod is held in a vertical position by a one-inch piece of pipe held in the concrete roof of the waste water sump. Lower end of the rod is attached to a metal float which is guided up and down inside a perforated piece of casing.

As the water level in the sump rises to the point where the lower clamp on the vertical rod comes in contact with the switch lever arm, the switch is turned on and the electrical motor started. Water is pumped from the sump until the float falls and the upper rod clamp contacts the switch lever arm to break the magnetic circuit on the magnetic switch, and the pump is shut off. This method of controlling the flow of water from the collecting sump is entirely automatic and has proved satisfactory, requiring little maintenance.





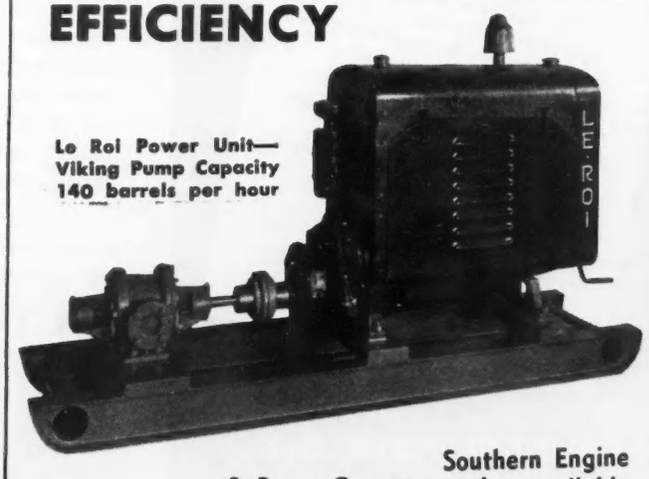
Wheatley pipe line pressure equalizers incorporate the principle of the air chamber without the objectionable features. Inert sealing fluid prevents air escape, minimizes formation of gum and corrosion. In successful use for ten years by major companies. Operating locations will be furnished on your request.

FRANK W WHEATLEY

TULSA . . . WHEATLEY . . . OKLA.

WRITE FOR LATEST "PUMPER" AND EQUALIZER BUL. CC436

THE RIGHT TEAM FOR EFFICIENCY



Le Roi Power Unit—
Viking Pump Capacity
140 barrels per hour

Southern Engine & Pump Company makes available to you 40 years of "KNOW HOW" in your pumping requirements.

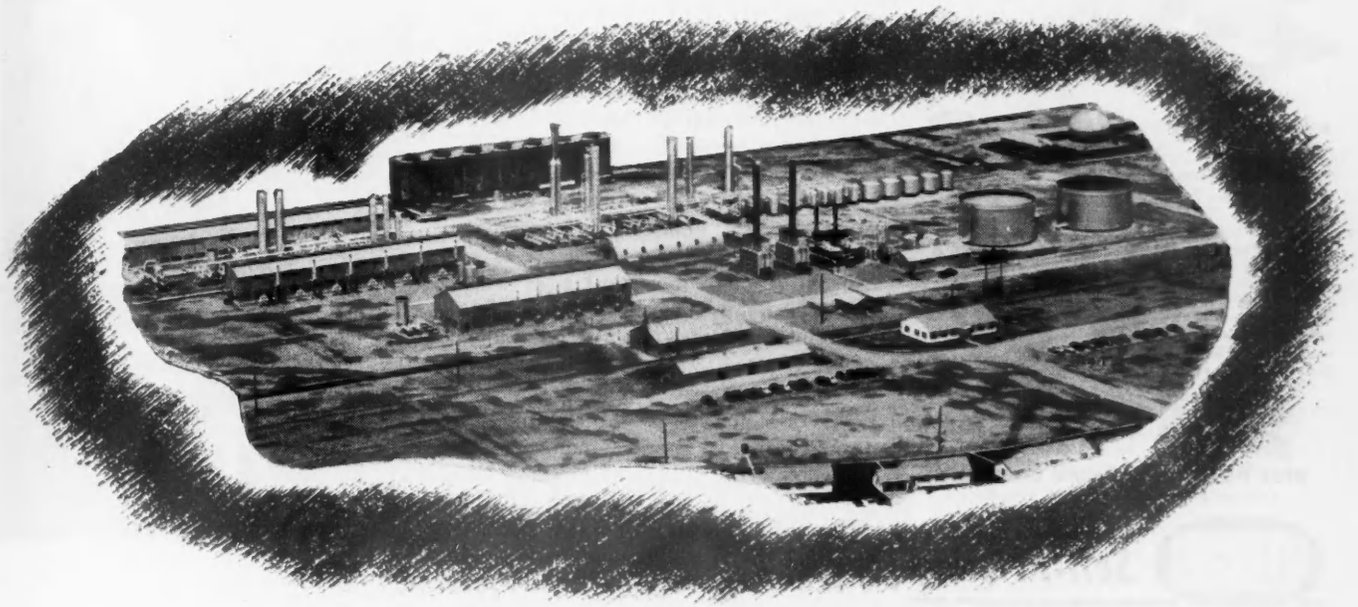
• Complete units and replacement parts at all branches.

SOUTHERN ENGINE & PUMP COMPANY

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS

Houston - Dallas - Kilgore - San Antonio
Edinburg - Lafayette, La.

AID CONSERVATION



25,600 CLARK "BIG ANGLE" HORSEPOWER SERVES MAJOR CONSERVATION PROJECT AT SLAUGHTER POOL, TEXAS

At the new Slaughter Pool Natural Gasoline and Gas Conservation plant*, Clark "Big Angle" Compressors are a vital part of a major conservation project. These units make up the largest compressor installation in the natural gasoline industry.

The plant is designed for the production of natural gasoline, butane and propane—from gas formerly burned off as flare gas. In addition, the dry residue gas is sold to a gas pipe line company for use as fuel.

Sixteen 8-cylinder "Big Angles", rated at 1600 BHP each, are used to compress about 90,000,000 cubic feet of "casinghead" gas per day from 13.2 psia to 713 psia in three stages—at a plant elevation of 3,000 feet.

The Clark "Big Angle" Compressors are aiding conservation by meeting the Oil Industry's needs for high-powered, heavy-duty, Gas-Engine-Driven Units. The BA has a wide operating range and is the most accessible for servicing of any compressor . . . saves money on both maintenance and installation costs.

WRITE FOR BOOKLET

For complete description, dimensional drawings and other data on "Big Angle" Compressors, send for Bulletin B-A.

CLARK BROS. CO., INC. • OLEAN, NEW YORK

New York • Tulsa • Houston • Chicago • Boston • Washington • Los Angeles
Birmingham • Detroit • Salt Lake City • San Francisco • Toledo
London • Buenos Aires • Caracas, Venezuela • Paris • Bucharest, Rumania
Lima, Peru • Bogota, Colombia • New Delhi, India

*THE SLAUGHTER PLANT IS OWNED BY: Stanolind Oil and Gas Company; The Texas Company; Honolulu Oil Corporation; Magnolia Petroleum Company; The Devonian Company; The Atlantic Refining Company; Saltmount Oil Company; Mid-Continent Petroleum Corporation.

COMPRESSORS ★ ★ ★

BELLOWS-TYPE CARTRIDGE SHAFT *SEAL*
A RICE PUMP FEATURE

Most Efficient Shaft Seal Ever Devised

- **Lubricated for Long Life**
- **Self-Contained — all parts within cartridge**
- **Double-Seals Pump Shaft**

Cartridge slips over shaft, bolts into position. No loose parts. No adjustments or alignments needed.

For other features of RICE PUMPS, see Illustrated Bulletins. Write —

10 M

Every RICE PUMP carries an A.G.C. Rating Plate.

RICE PUMP & MACHINE COMPANY
Division Milwaukee Chaplet & Mfg. Co.
1047 S. 40th Street
Milwaukee 4, Wis.

RICE *Self-Priming*
CENTRIFUGAL PUMPS

Longer Thread Life
WITH *Jimmie Gray*
COMPOUNDS

KANT-GALL TOOL JOINT COMPOUNDS

EXCLUSIVE 500-TON SPECIAL

LONG-LIFE DRILL COLLAR COMPOUND

You can always break the joint when you use Jimmie Gray Compounds! That's because each one is engineered to do certain specified jobs best! You can depend on their thread-protecting film to prevent galling and washouts, too. Satisfaction is assured thru the famous Jimmie Gray money-back guarantee!

SOLD BY SUPPLY STORES EVERYWHERE

FORMERLY STANDARD OIL SALES CO.

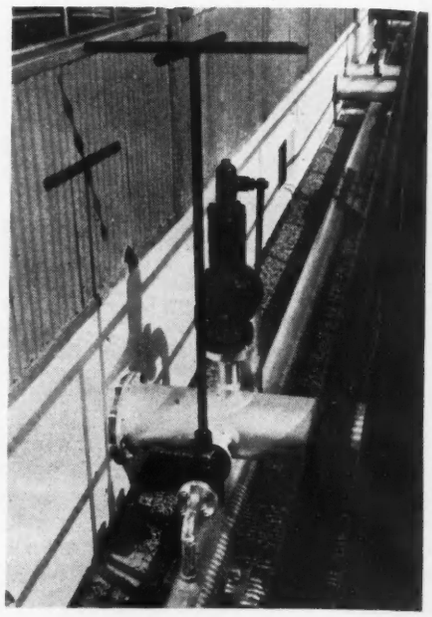
PETROLEUM DISTRIBUTING CO.
BOX 203—HOUSTON, TEXAS
CHarter 4-5648

HOW TO—Relieve Discharge Pressure

Compressor popoff line and discharge pressure bleed line have been incorporated into one common header to provide safety and convenience in reducing the pressure in the discharge piping. An eight-inch pressure relief header was mounted on concrete foundation blocks so that it traversed one side of the compressor station building where both the intake and discharge manifolds were located. Several hundred feet from the station, the pressure relief line was exhausted through a vertical riser which extended about 30 feet into the air.

A combination automatic and manual pressure relief valve was mounted into the header as shown. Near the same point of connection into the pressure discharge line, a smaller, manually-controlled bypass was added. This line, 1¾-inch in diameter, was equipped with a plug valve, the stem of which had been extended by a shop-made handle and stem. A box welded to the lower end of the stem fitted snugly over a square shoulder of the valve stem, and was held in place by a lock screw.

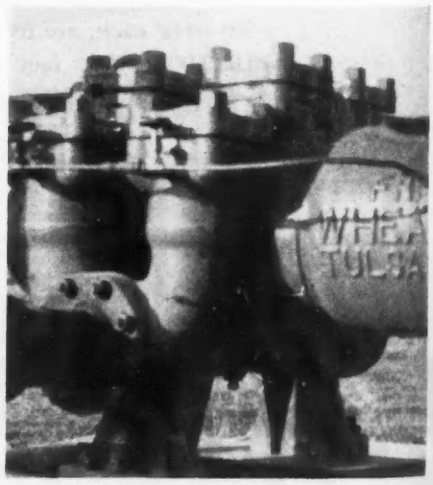
In the event the discharge pressure exceeded normal line operating pressure, the relief valve would pop to discharge gas through the pop line. When it was necessary to repair any one of the compressors, the discharge line valve was closed off and the pressure bled through the manual bypass shown. A yellow dot on the extension handle indicated the position of the valve plug.



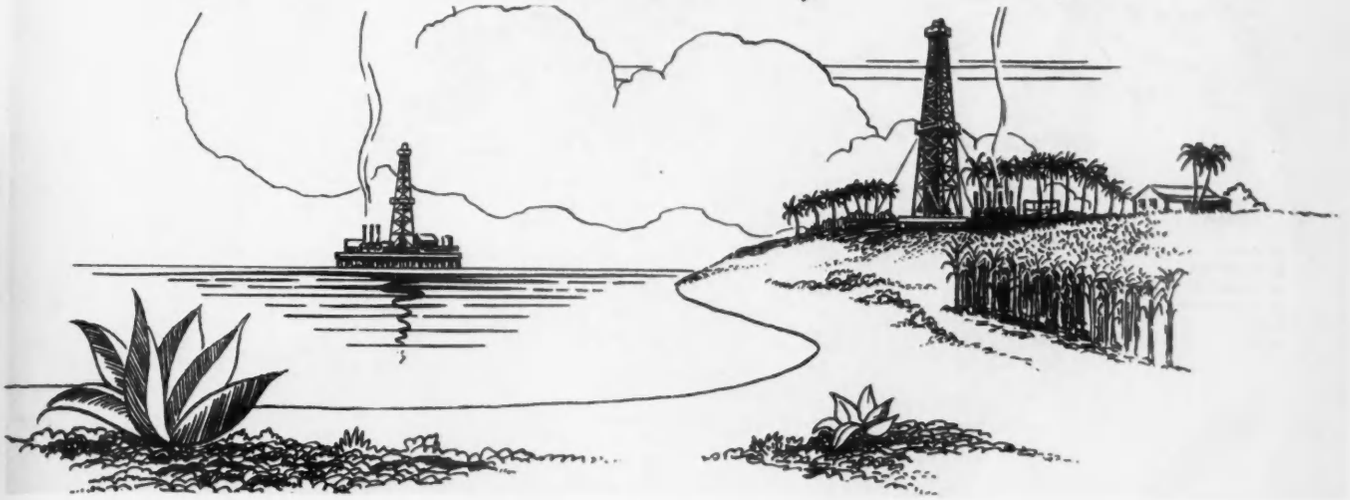
HOW TO—Lubricate Pump Piston Rods

A simple connection may easily be made on a pipe line pump which will keep the suction of the pump free of air and at the same time lubricate the pump rods. A tap for a quarter-inch connection is made on the top of each suction valve housing and quarter-inch needle valves installed. The two valves are connected together as shown and copper tubing run through the piston rod housing where a tee is installed and a line leads to each of the piston rods. Beneath the rods, one-inch lines connect together and lead to the sump tank the outlet of which is connected back to the pump suction.

By slightly opening the needle valves and adjusting the flow, the outer ends of the piston rods are lubricated and they are not dependent on the oil from the inside of the rods. If any air or gas is drawn into the line, it can easily be released through the same connections. The valve on the sump tank remains closed until it is partly full, then it is opened and the fluid allowed to run through the pump until the level is lowered.



Cuban Activity Resumed



BY SIGURD SCHOLLE
Vice President
Southeastern Oil, Incorporated

LITTLE attention has been paid during the past 12 months to reports by travelers returning from Cuba that Varadero Beach and the province of Camaguey were buzzing with oil-leasing activity. The Cuban press remained indifferent even when it became obvious that at least four major companies were quietly taking out exploration concessions covering vast areas. It is a matter of conjecture how the complete news blackout was achieved. Then, without any warning, the news broke on August 13 that Gulf Oil Corporation had spudded in, the day before, its first deep test in the shallow, calm waters of Cardenas Bay, two miles offshore, south of Cayo Diana, and just eight miles north of the port of Cardenas. The Cuban newspapers carried pictures of the ceremony, showing the President of the Republic immaculately attired in white and decidedly handsome as he stood at the brakes of the drawworks.

The secret was very well kept, indeed, considering that prior to this ceremony Gulf had made elaborate geological and geophysical surveys, as had other companies, in various parts of the north coast of Cuba. Informed observers claim that during the last 24 months Gulf spent more than $2 million in Cuba, a sum which indicates the scale of the work done before the first spin of the turntable.

Besides the location in the Bay of Cardenas, Gulf has selected three more locations for deep drilling. One of these is southeast of the first well, in the Bay of Cadiz; another is in the Bay of Santa Clarita (north of the small shallow field of Motembo), and a third is near the port of Nuevitas in the province of Camaguey. The Gulf concessions reach along the north coast of Cuba from the Bay of Cardenas in the province of Matanzas to the Bay of Nuevitas in the province of Camaguey, taking in a substantial strip of the mainland and all the bays and islands offshore to the deep-water line. Interspersed are concessions taken out by Standard Oil Company (N.J.), Shell and The Atlantic Refining Company. Only recently Shell converted exploration rights near Cayo Cocos in the province of Camaguey into an exploitation concession. This suggests that several majors have pooled their operations on the north coast of Cuba under Gulf drilling management.

Other Good Prospects

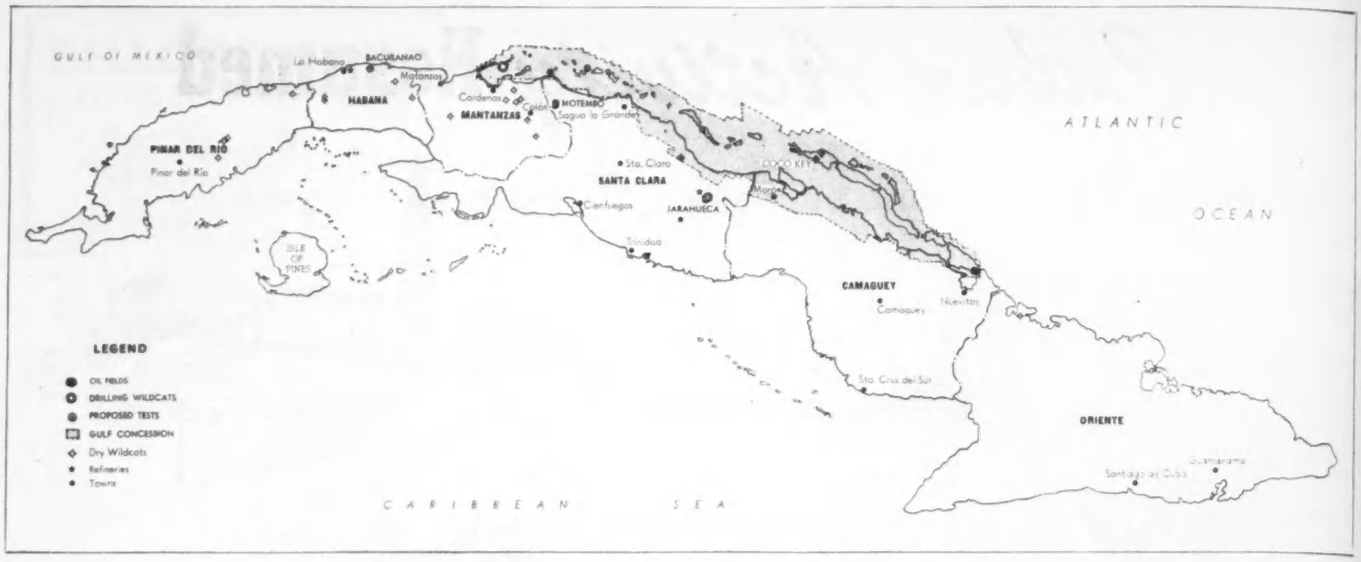
Interest, however, is not confined to the north coast, and recent geological reports attach even greater significance to the south coast and to certain inland sections. One reason may be that the thick layer of asphalt found on the bottom of Cardenas Bay near the location of the first well indicates the presence of considerable seepages which may have caused disturbance of the trapped formations. Seepages appear to be less pronounced on the south coast. All along the north coast the survey has found conclusive evidence of the same type of domes that exist off the east coast of Mexico in the Gulf of Mexico. According to a recent report by Jorge Broderman, chief geologist of Cuba's Department of Mines, deposits of asphalt and the evidence of gas are found in every province of the island. Still, the accumulated production of the country since 1917 is only a fraction more than 2 million barrels of crude and naphtha.

Of the three discovered fields, Motembo and Bacuranao are shut down. The only producing field is Jarahueca with a daily total of 600 barrels. The latest well drilled in this field had a flush production of 400 barrels daily from a depth of 2000 feet and is now flowing 200 barrels a day of high gravity oil. An extension of this field is planned; also two wells are now drilling in an effort to reopen the Bacuranao field.

The Cardenas well is the first test of the Cuban continental shelf, which has a length of about 2000 miles. Compared with offshore drilling off the coasts of Louisiana and Texas, the conditions seem to be almost ideal. The bay is well protected and rather shallow. At the location, eight miles from shore, the depth of the water is 15 feet. In a paper submitted to the United Nations conference on the Conservation and Utilization of Resources, Mercer H. Parks defined the term "relatively shallow water and favorable locations" as applying to wells located in as much as 60 feet of water, 70 miles from base and 30 miles from the shoreline. As an offshore drilling venture, the Cardenas well has a perfect setting.

The understructure of the heavy-duty rig, which is capable of reaching 15,000 feet, is erected on a platform which rests on 260 hardwood piles driven to an average depth of 60 feet into the limestone. On September 21 the well was down to 2200 feet and beyond the danger zone where cavings in the limestone had been feared. Top of Eocene was reached at 1636 feet and Upper Cretaceous is expected below 3600 feet, with first probable oil horizon near that level. Traps are anticipated in the Aptichus Limestone (Lower Cretaceous) at 8000 to 9000 feet, probably early in 1950.

In his same paper, Parks points out



that sea transportation is of primary importance in offshore operations. While in the Gulf of Mexico only few deep-water ports are available, Cuba has a number of excellent ports and in this instance the port of Cardenas is only eight miles south of the location.

No predictions will be ventured at this time, but the fact that Gulf after expending more than $2 million in exploratory work, decided to embark on the costly project of offshore drilling, is a sound enough basis for the expectation of favorable results.

Oil reserves and production in Cuba would be of great economic and strategic importance, possibly obviating the necessity of looking for oil sources far from home, which may be of little value in the event of an emergency. The future will show what fraction of the ½ trillion barrels of reserves locked in the earth's continental shelves can be extracted from the submerged lands surrounding Cuba. In the light of these developments it appears worthwhile to take a look at Cuba's oil legislation.

Cuba's Mineral Fuel Law was approved by President Frederico Laredo on May 9, 1938. It is a striking coincidence that on March 18 of that same year President Lazaro Cardenas of Mexico signed the oil-expropriation decree. The two measures taken almost simultaneously by the chief executives of the two countries, both Latin American, reflect two opposing concepts of economic planning. While Mexico took the road of complete nationalization and state monopoly, Cuba elected to give competitive private enterprise free rein to develop the country's oil deposits in free competition and wholesome rivalry.

In the face of the happenings in Mexico, Cuba stood firm in the belief that only the interplay of diversified talent and the continuous fight to stay in the race would bring about results. In keeping with the ideology of free-for-all competition, foreign participation in the oil industry has equal status, the only condition being that concessionaires of foreign nationality be legally domiciled in Cuba.

Foreign Shareholding

The fact that the exploitation of areas declared national reserve will be granted exclusively to Cuban companies does not mar the clear trend, because no restriction of foreign shareholding is imposed. The oil law of Cuba and the regulations given by Presidential Decree No. 2625 on October 16, 1939, are certainly not without flaws, and a comparative analysis of oil laws of other Latin-American republics may reveal that the Cuban law could be improved. On the other hand, it can be stated that the major sector of the oil industry rates the Cuban law as a clear-cut and safe structure for foreign investments. That is borne out by the fact that a number of major companies have broken ground for operations, and probably will invest heavily as time goes on.

It is of little practical consequence that the mineral rights are given the now familiar halo of inalienability, because in the same Article IV of the law clear authority for the chief executive is established to convey the right of exploration and exploitation of the mineral deposits in the form of concessions.

The structure of the law follows the exploration-exploitation pattern adopted by all Latin-American countries, which is also the basis of the leasing procedure in the province of Alberta, Canada for lands settled since October 31, 1887. While in the proposed Brazilian law the conversion from exploration to exploitation concession is strictly at the discretion of the chief executive, the Cuban law establishes unequivocally the right of the bona fide explorer to the title provided that he has met the obligations of the exploration concession. The area of individual exploration concessions is restricted to 32,000 hectares (76,800 acres) and the total area allowed to any one person or company is 300,000 hectares (720,000 acres). Reliable reports indicate that Gulf, Standard, Shell and Atlantic have obtained a total area of about 5 million acres, either directly or through affiliates. Sixteen million acres are held by independent American and Venezuelan operators, and from 3 to 4 million acres probably are in the hands of Cuban interests.

The procedure prescribed for the grant of exploration concessions starts with what is called "denouncement," which can be rejected by the government or given provisional acceptance. In the latter case the concessionaire deposits one year's rentals plus the usual incidentals for survey and publication—altogether about $440 for an area of 32,000 acres. Thereafter he is sure to receive the concession for any part of the "denounced" area which does not overlap existing concessions. After completion of the land survey, the final title to the concession is issued for a term of three years by the Central Mining Department in Havana, the preparatory work having been done by the Mining Department of the respective provincial governments. During this three-year term a surface tax of 6¼ cents per year-acre is payable.

At any time during the exploration period application for an exploitation concession, covering seven-eighths of the exploration area, can be made, providing the concessionaire has lived up to the obligations of the exploration concession, of which quarterly progress reports are probably the most important requirement. The grant of the exploitation con-

The *Real* Test of a Packer

IS IN *YOUR* WELL

No matter what anyone tells you, the payoff on any piece of equipment is what it does for you. And we're glad it is. For, once an operator uses Lane-Wells packers, sees for himself their distinct advantages, checks their low operating cost and realizes what long service they give—the chances are mighty good that *all* his packers from there on will be Lane-Wells Packers.

Five things operators particularly like about Lane-Wells Packers: 1. They run in easily through fluid, due to a generous by-pass. 2. They pack off securely, giving leakproof service as long as you ask. 3. They *don't* freeze to the casing, or wreck themselves coming out. 4. Complete selection through 13 types and 328 different packers. 5. Full stocks of all the most wanted packers in all the commonly used sizes ready for you in 46 Lane-Wells branches.

In any field, ask the operators who use Lane-Wells Packers, or call your Lane-Wells field man for the complete story on what Lane-Wells packers will do for *you*, in *your* well!

LOS ANGELES · HOUSTON · OKLAHOMA CITY
General Offices, Export Offices & Plant
5610 So. Soto St., Los Angeles 11, California

LANE WELLS
for Packers

Lane-Wells Service and Products Are Available Thru Petro-Tech Service Co. in Venezuela

JP-288

cession follows almost automatically. In the process of conversion to exploitation concession, the concessionaire surrenders one-eighth of the explored acreage to the government for incorporation into the national reserve. Following certain geometrical rules laid down by the law, the total area is divided into eight equal lots of which the concessionaire has first choice of one. Subsequently, the government selects the lot to be incorporated into the national reserve. The same general principle is adopted by other Latin-American oil laws in a variety of designs for the equitable solution of the problem of how to reduce to a minimum the element of gamble and chance in the selection of the government's share in explored acreage. Critical observers think that this provision is one of the less appealing features of the Cuban law.

Effective from the date of the final grant of the exploitation concession and irrespective of results obtained, the concessionaire is to pay a yearly surface tax of 4.17 cents per acre for the first 10 years, 8.34 cents for the next 10 years and 16.68 cents for the remaining 10 years. The drilling obligations are very mild compared with the oil laws of other countries: one well within a period of five years from the date of the title, and not a deep well at that. The provisions require the drilling to 4000 feet unless commercial oil, defined to be in excess of 122 barrels a day, is found at a higher level.

The royalty to the government is 10 percent in kind, or its cash value at the wellhead. The royalty is reduced to 9 percent if the crude is shipped to a refinery on Cuban territory. The landowner receives 1 percent royalty as total indemnity for loss, damage and right-of-way. The operator must make separate arrangements for the physical value of the surface occupied for permanent structures, but it is most likely that landowners will not jeopardize the chance of royalty payments by over-charging for what little may be the physical value of the rural property.

Wherever oil will be produced in Cuba, shipping to deep water will entail but little cost and trouble. Nature has endowed the island with numerous excellent ports and an ideal topography for laying pipe lines, none of which would be required to be in excess of 60 miles in length. Pending the construction of pipe lines, wells will not have to be capped. An all-weather central highway traverses the whole length of the island and the government is about to improve and extend the existing system of secondary roads.

While the petroleum law now under consideration by the Brazilian Congress is prohibitive to integrated operation, in that private ownership in transportation and refining facilities is restricted to 40 percent, pipe line operations in Cuba are brought under a similar system of concessions, as is production. Pipe line concessions are granted for a term of 30 years. All lines are given the character of public carriers, the distinction between the three classes established by the law being that the so-called private lines are public carriers only to the extent of 11 percent of their capacity, while the others may be called on to carry government oil or oil from private operators up to 20 percent of their rated load.

Refining operations and the construction of plants do not come under any concession system and are not subject to any regulation other than indicated by the safety of operations and the obligation to place a pro-rata share of their capacity at the disposal of the government, if so required for domestic consumption, and against payment of cost plus a reasonable industrial profit. The total amount of the processing toll for the government cannot exceed a modest size.

Cuba's Imports

In addition to the domestic crude from the Jarahueca field, a matter of about 18,000 barrels a month, Cuba imported in May this year 49,000 barrels of gasoline, 4500 barrels of aviation gasoline, and 248,000 barrels of crude from the U. S.; and 85,000 barrels of fuel oil from Venezuela. The total capacity of the three existing refineries in Cuba is 4900 barrels of which 4200 barrels are processed at the Belot plant of the Standard Oil Company of Cuba.

Three more points of importance are worth mentioning. One is that the law expressly guarantees that production, refining and transportation shall not be encumbered by other than general taxes, and that taxes imposed by the oil law shall not be increased. In the opinion of the writer this guarantee can be considered as a strong enough protection against measures as taken by the government of Venezuela in the form of the so-called "50-50" amendment to the income tax law passed in 1948. This amendment in effect created an additional income tax since the tax is applicable only to mining and hydrocarbon companies, designed to assure that the government receives in taxes no less than the companies receive in profit. This kind of a special tax is expressly outlawed by Cuban oil statutes.

Another point of importance concerns labor. Except for drillers and toolpushers of foreign nationality, who may be employed during the life of the concession, the law provides that whenever possible 85 percent of the other technical personnel employed in drilling operations should be of Cuban nationality from the beginning of the 11th year of the concession. This arrangement may well be called a fair deal.

The same may be said for the provisions exempting the export of crude and refined products from duties or other special taxes. The law also provides that no change in this setup shall be applicable during the life of the concession.

In closing, one word of caution may be in place. Granted that the program of Gulf's drilling operations opening up the Cuban continental shelf (never before reckoned with in the evaluation of America's offshore potential oil lands) justifies great hopes for Cuba's economy; and granted further that Gulf's expenditure of a small fortune in exploratory work, together with future large projected expenditures in Cuba, at a time of apathy toward the opening of new fields, is evidence of the measure of faith in the success of the venture—still no deep oil has been found yet. And it must be remembered that Shell abandoned its deep test in Cuba at 10,563 feet in August, 1947. The official ceremony in the Bay of Cardenas was well worth the effort of scrubbing the derrick floor, because the first attempt to drill in 15 feet of sea water may be the turning point in Cuba's oil history. Oil men probably will remain cool and collected until they see the figures of the "potential test." Caution against building up great expectations at this moment is the better part of wisdom.

About the Author

SIGURD SCHOLLE was born in Danzig, took postgraduate and law degrees in Germany and France, and has a background of 15 years law practice, mostly in international and admiralty law. He has been active in drilling operations in Texas and Oklahoma, and has done extensive research work on Mexican and Central and South American oil matters. He was named a delegate to the United Nations Conference on the Conservation and Utilization of Resources.

NORRIS SUCKER RODS

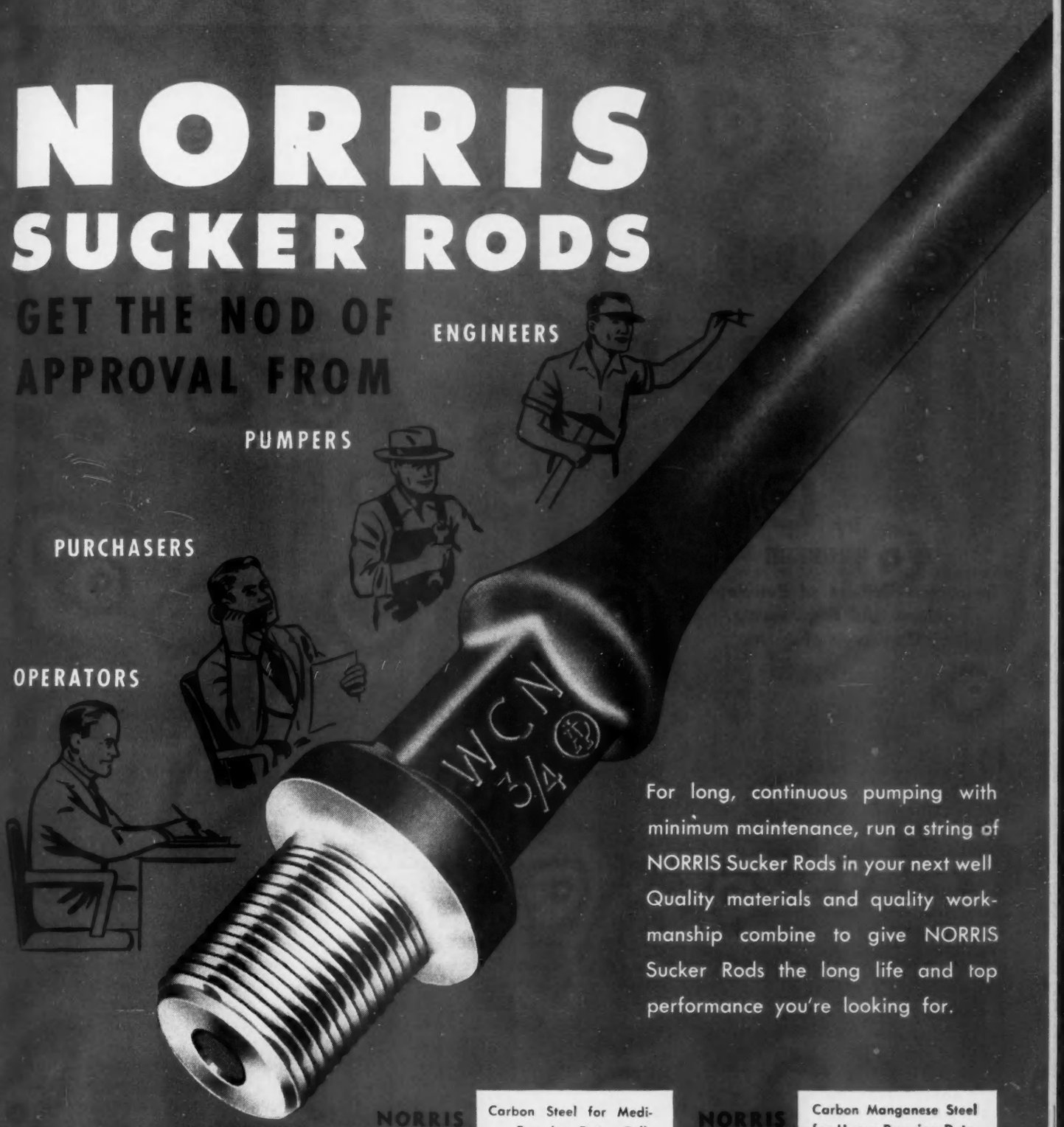
GET THE NOD OF APPROVAL FROM

ENGINEERS

PUMPERS

PURCHASERS

OPERATORS



For long, continuous pumping with minimum maintenance, run a string of NORRIS Sucker Rods in your next well. Quality materials and quality workmanship combine to give NORRIS Sucker Rods the long life and top performance you're looking for.

NORRIS TYPE 20	Carbon Steel for Medium Pumping Duty. Fully Normalized.	**NORRIS TYPE 30**	Carbon Manganese Steel for Heavy Pumping Duty. Fully Normalized.
NORRIS TYPE 40	Nickel Moly Steel for Heavy Pumping of Corrosive Crudes. Normalized and Tempered.	**NORRIS TYPE 50**	High Nickel Moly for Heavy Pumping of High Corrosive Crudes. Fully Normalized.

W. C. NORRIS, MANUFACTURER, INC.

TULSA, OKLAHOMA

BRANCHES:
HOUSTON, KILGORE, ODESSA, TEXAS;
SALEM, ILLINOIS; CASPER, WYOMING

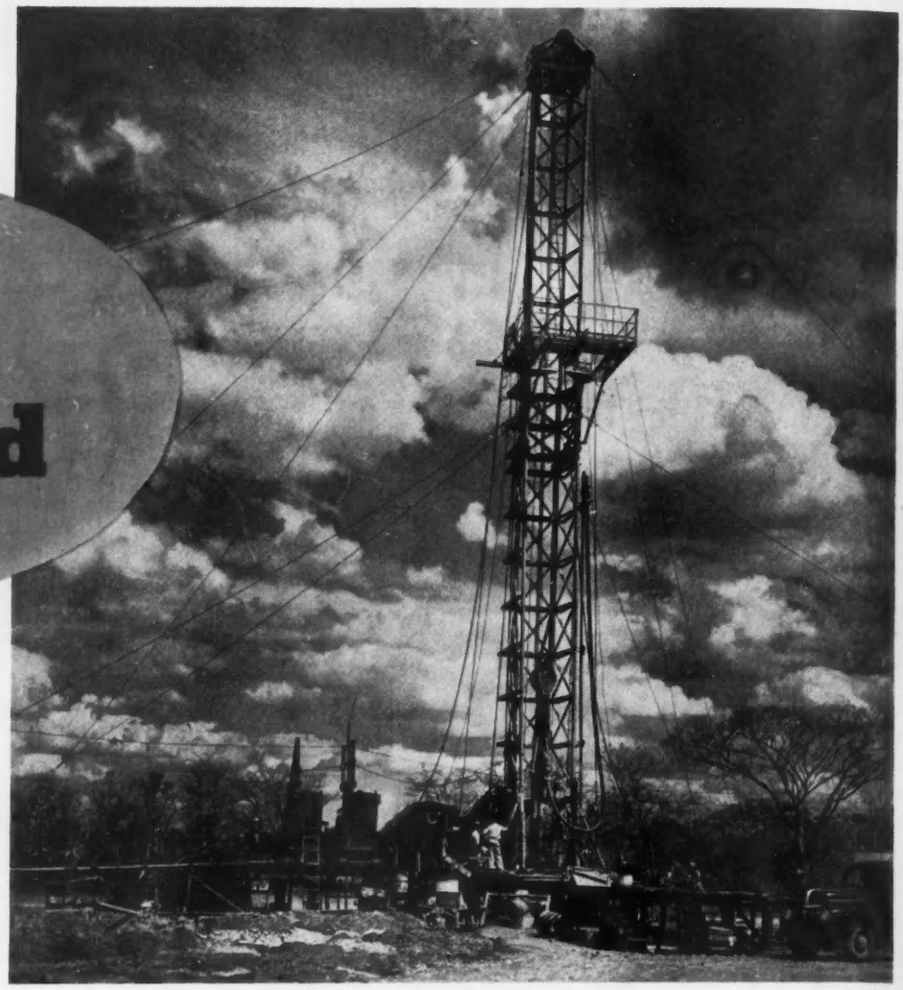
EXPORT: 30 ROCKEFELLER PLAZA, NEW YORK CITY

Since QUALITY NORRIS PRODUCTS 1882

WEST COAST DISTRIBUTORS:
HICKEY PIPE & SUPPLY CO.
Los Angeles

Oil Abroad

By
E. E. BARBERII
Instructor, College of Petroleum Sciences and Engineering, University of Tulsa



Type of equipment chosen is dictated by terrain, personnel and down-the-hole conditions expected.

OIL companies venture out from home-base in the search for oil or for the establishment of marketing operations in foreign lands for the following important reasons: (1) to gain access to new reserves; (2) to supply world oil demand from more strategic geographic points; and (3) to increase the organization's fixed assets and to maintain or improve its competitive position within the industry at home and abroad.

Reasons two and three are self-explanatory, but the broader aspect of point No. 1 is not so well understood by some within the industry, let alone by the public at large. Foreign oil operations are not complicated but they embrace a more extensive field of policy and coordination than those experienced in the continental U. S.

Basic Foundations

To gain access to new reserves in foreign countries requires a special organization with somewhat independent powers of action from the parent company and with: (1) sufficient working capital to meet the requirements of the outlined working program and unexpected disappointments; (2) grade A management, well acquainted with foreign operations and thoroughly familiar with the country chosen for the new venture; and (3) working personnel—technical and non-technical—capable of ready adjustment to new working conditions and, above all, flexible enough in character to understand satisfactorily the people of the country where operations are contemplated.

The foundations for oil field development and exploitation abroad are so intimately related that weakness in any one of the three will prove to be highly detrimental to the over-all efficiency and future success of the organization as a foreign oil operator.

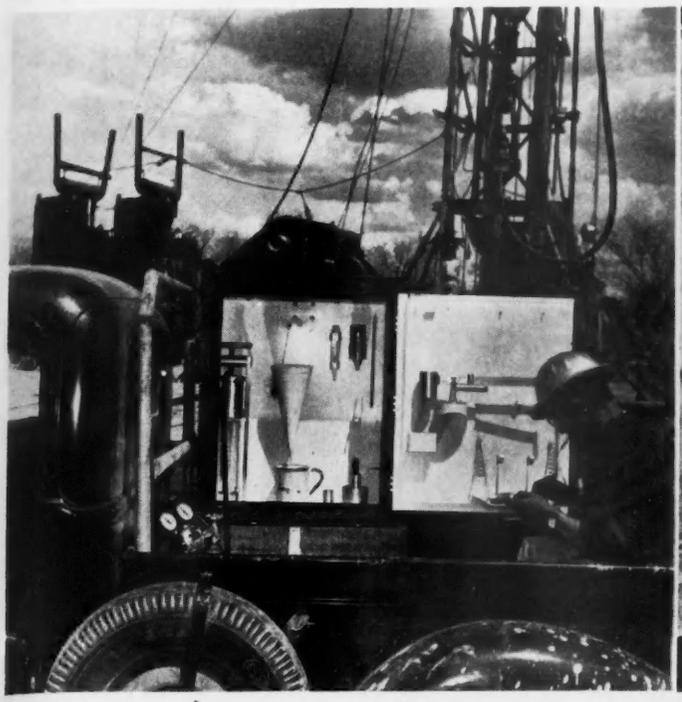
Legal and Economic Aspects

First of all it is well to remember that outside the U. S. the mineral rights are wholly owned by the nation and not the individual in the majority of cases. Such is the case of all Latin American countries. In Europe and the Middle and Far East the situation follows the same status of sovereign domain with certain modifications. Therefore, transactions for the right to obtain permission for the development and exploitation of desired acreage will be made not with individuals but with a sovereign power.

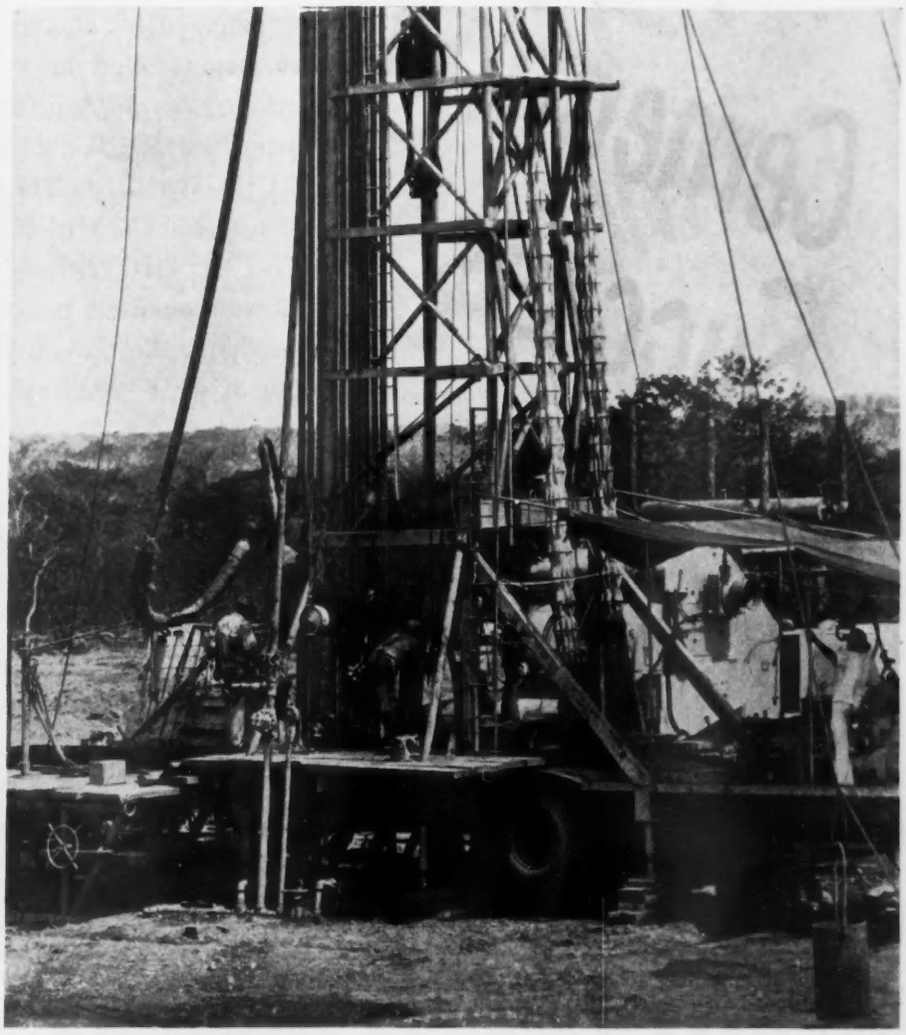
Under such circumstances it can be seen that any foreign party or organization willing to enter a chosen country for the purpose of developing that country's oil reserves must take into consideration

AMERICAN CAPITAL, participating in foreign enterprise, should familiarize itself not only with legal considerations involved, but also the economic standing of the industry within the country as well as the economic strength of the country itself. In addition, a special type of organization is required, with sufficient capital to bridge disappointments in an over-all program and with sufficient freedom of action to meet emergencies of all types.

Personnel should be ready, not only to lend its technical skills, but to adjust itself to a new language and to a new set of customs, traditions and statutes in its dealings with nationals of a foreign country.



LEFT: Over-all checking of mud characteristics is a daily routine in drilling a well, yet this work is important to a successful completion.
RIGHT: Constant checking of drilling fluid viscosity is a must on every rig. Explanation to the national crew of the importance of maintaining good mud in the hole is part of the engineer's job.



LEFT: Measuring sand content of drilling mud.
RIGHT: National crew members handle American-made equipment efficiently when well instructed and coached about its characteristics, manipulation, etc.

"Whirling on center" is the key to Cementing Success

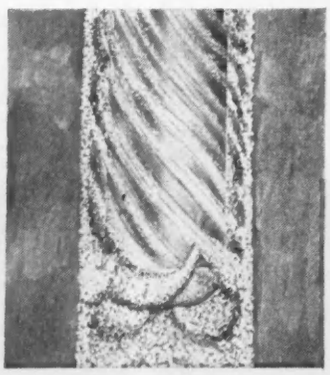
NO OTHER EQUIPMENT—no other method of cementing—provides such assurance of successful "first-time" cementing as the exclusive Baker Principle of "whirling" the cement up and around casing which is effectively centered in the well with Baker Model "G" Casing Centralizers.

Not only can you REMOVE BRIDGES which might stick the casing; not only can you wash the wall of the hole to help REMOVE MUD CAKE and leave the formation prepared for effective bonding with the cement to follow, but the definite *downward*, then *upward* whirling motion of the cement slurry REDUCES THE HAZARD OF CHANNELING TO A MINIMUM, and assures COMPLETE ENCASEMENT OF THE PIPE at the critical shoe joint with a uniform body of cement.

Study the illustrations below for visual proof of what "whirling" means to you.

The downward hydraulicking action of the circulating fluid through the baffled side down-whirler ports, and the nozzle-like bottom passageway, effectively remove bridges and permits safe running of the casing string.

When washing the formation at the cementing point to condition the hole, the "whirling" motion of the fluid helps remove mud cake from side walls. This *downward* whirling is far superior to any *side* jetting action, and does not cause caving or crumbling of soft formations.



The "whirling" motion given to the cement slurry as it is discharged from a Baker Wash-Down Whirler Shoe causes the cement to encase the centered shoe joint with a uniform body of cement, and reduces to a minimum the hazard of channeling.

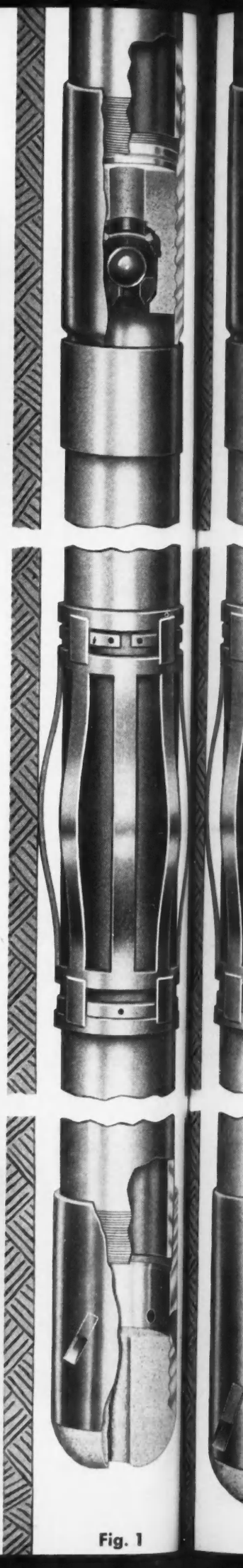


Fig. 1

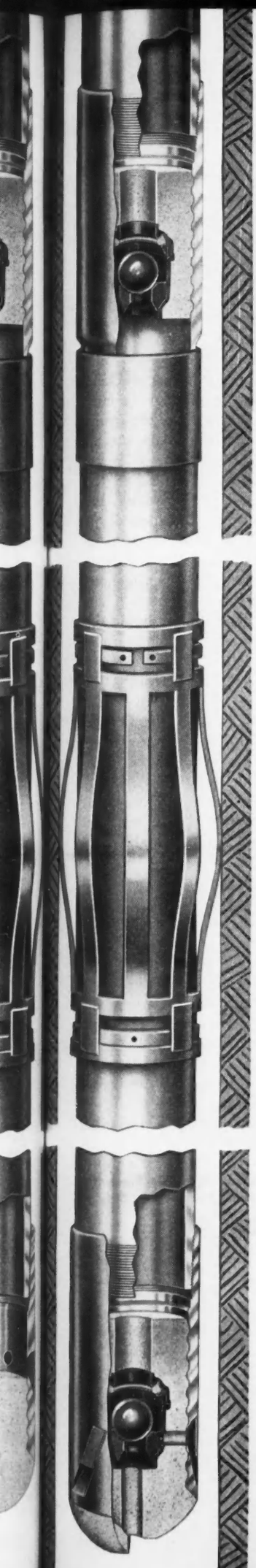


Fig. 2

EVERY cementing job should be performed with equipment which provides maximum FLOATING EFFICIENCY • LANDING EFFICIENCY • CEMENTING EFFICIENCY . . . with COMPLETE DRILLABILITY and PROVEN DEPENDABILITY

When you use Baker Cement Equipment you *know* that the buoyant ball will seal against the resilient rubber ring (backed by sturdy interior construction) to provide leak-proof strength for FLOATING those long, heavy strings of casing. You *know* you can raise and lower the string to insure PERFECT LANDING at the desired depth. You *know* you will secure maximum CEMENTING EFFICIENCY by the "whirling" cement slurry, combined with COMPLETE DRILLABILITY. You will enjoy that peace of mind which comes from using equipment of PROVEN DEPENDABILITY in thousands of jobs under every imaginable well condition.

RESULTS ARE WHAT REALLY COUNT

You are assured of RESULTS when you use Baker Hook-Ups like those pictured at left. For wells up to average depth, use a Baker Cement Wash-Down Whirler Guide Shoe (Product No. 121) with Baker Model "G" Casing Centralizers (Product No 910-G) spaced throughout the cementing area to provide *maximum centering force at the cementing point*. Then with a Baker Cement Float Collar (Product No. 101 M&F) positioned a joint or two above the shoe, you have the world's best "float valve" for safety, plus a "stop" for the cementing plug so that cement tailings are retained inside of the casing. See Figure 1.

For deeper wells, where maximum "floating" strength is a worthwhile precaution, a Baker Cement Wash-Down Whirler Float Shoe (Product No. 120) used on the bottom of the string (Figure 2) gives double safety at negligible cost.

YOU GET EFFICIENT RESULTS WHEN YOU COME TO "CEMENTING HEADQUARTERS"

Call the nearest Baker representative or office. Find out how dealing at Cementing Headquarters means SUPERIOR RESULTS FOR YOU!

BAKER OIL TOOLS, INC.

HOUSTON • LOS ANGELES • NEW YORK

Only BAKER Cementing equipment provides whirling action

many important factors which will affect the organization and its operations directly.

The legal aspect should cover a detailed study of the country's government attitude toward the oil industry. This study will embrace the different aspects of the laws covering the granted acreage with respect to ownership, time, special fees and taxes for the period of exploration work, and initial development operations. A clear-cut study should be made as to taxes and royalties to be paid during the intermediate and final stages of exploitation of the reserves tapped.

The legal aspects of state regulations governing the technical phase of reservoir management and disposal of the fluids extracted therefrom should be carefully scrutinized. Commitments for the erection of refining installations, auxiliary plants, transportation and shipping facilities for company and public use should be carefully studied with respect to all current statutes.

A complete study of the oil industry's economic standing within the country and the country's economic strength in relation to the rest of the nations of the world is necessary. This study will cover world oil production and demand, transportation facilities, export and import regulations, prices, and incentives.

The oil industry being largely what it is, a truly American enterprise in all shapes and forms, foreign operations depend heavily on American know-how and equipment to accomplish the desired results. This means that men and equipment will travel to far-off places. Their journey will be governed by certain immigration rules and the equipment will be subject to import duties. This aspect of the venture merits careful consideration since the organization interested in the services of these men and equipment is responsible to custom and law enforcement officers for their presence in the country.

To guide the executive and field management in their daily relations with the national labor force it is important that all national labor laws and the status of unions or syndicates be carefully studied and understood. Correct visualization of the labor movement within the country is a primary requisite for the attainableness of harmonious relations between the organization and the working force.

The Management

To the management of the newly established concern falls the responsibility of outlining long range organization policy. A considerable number of tasks totally different from those experienced at home will confront the executive board. Learning and feeling their way around in the new environs is not an easy undertaking. Proficiency along these lines is a matter of time, painful observations, and willingness to understand the importance of every little mechanism which shall contribute to the performing efficiency of the organization under the shadows of new operating conditions.

Aside from becoming familiar, or learning more about the legal, economic, and engineering factors which directly affect the company, the management should be thoroughly acquainted with the national customs and traditions. This knowledge is more important than people realize; it is the foundation on which the good will of the people toward the company is to be based. In return, the people of the nation and the national interests will appreciate the consideration and courtesies given and will uphold the company's emblem accordingly.

The management of men is a complicated subject and becomes more intricate when the managing and the managed group are of different nationalities. To fill this gap, an accurate knowledge of the national language is a primary requisite. This simple fact is of great importance to the personal success of every member of the expatriate force. The management, through the industrial and public relations department, should direct its best efforts to make the company policies known to the expatriate and national employes and also to the public. These efforts should be aimed at the establishment of the organization as a part of the national life and economy.

Field Personnel

The technical and non-technical personnel will find abroad a multi-million dollar American oil industry serving and benefiting those countries where it operates. The prestige of American enterprise abroad rests on the shoulders of the expatriate engineer, geologist, foreman, supervisor and skilled worker.

The newcomer should realize that different customs, traditions, and working conditions await him in that far off land he has chosen to journey to. His work is to be done with the assistance of national hands. The success to be attained depends largely on how well the engineer or foreman understands the national language and what degree of progress he has made, after reasonable stay in the country, in assimilating those conditions of life and work indigenous to the region and its people.

The American technician should be ready, whenever the opportunity is given to him, to lend his talents to the development of new areas. Furthermore, he should contribute to the welfare of the people of those areas by imparting to them good teaching in order to bring about the development of hidden skills his subordinates might have. This particular aspect of the job is of paramount importance to the supervisor's personal desire to have under him capable and dependable men.

Typical of what the oil industry capital and know-how can do when given a chance is found in Venezuela, the world's second oil-producing country and the world's largest exporter of crude petroleum. This accomplishment is the work of mutual understanding between the operating companies in the country and the Venezuelan government.

To give an idea of the oil development in Venezuela, whose oil producing activities did not show in the world oil market prior to 1917, the following table is in order.

Venezuelan Oil Production (First Semester 1949) Average Daily Production, Bbls.

American Companies	
Creole (Standard Oil)	590,288
Mene Grande (Gulf)	160,165
Socony	34,006
Sinclair	16,470
Texas	21,161
Las Mercedes (Texas)	15,135
Atlantic	9,613
Phillips	3,021
Richmond	3,224
Total	853,083
English-Dutch Companies	
Shell Group	381,431
Others	1,690
Grand Total	1,236,204

About the Author

E. E. BARBERII was born in Tucupita, Delta Amacuro, Venezuela. He is a petroleum engineering graduate from the University of Oklahoma, 1944, and during summer vacations he worked in the Oklahoma and Kansas oil fields. In 1944 he returned to Venezuela and joined the petroleum engineering staff of Creole Petroleum Corporation. In 1946 he accepted a position as field engineer with Phillips Venezuelan Oil Company. He returned to the U. S. in 1947 and worked as associate editor of *Petroleo Interamericano*, and at the same time attended the graduate school of the University of Tulsa. At present he is an instructor in the College of Petroleum Sciences and Engineering, University of Tulsa.

Wülfel

OILFIELD-EQUIPMENT

Type AW140/2 Double Drum Truck-Mounted Hoist.
Max. Line Pull 20,000 lbs.

60 More than
Years experience in Mechanical Engineering
20 and more than
Years experience in the design and manufacture of Oilfield-Equipment gained in all oilfields of the world are embodied in our high quality products:

PUMPING UNITS • CENTRAL POWERS • SINGLE OR DOUBLE DRUM WINCHES • TELESCOPING MASTS • ROTARY POWER TRANSMISSIONS • CANTILEVER DRILLING MASTS WITH WUELFEL GEAR TYPE DRAW WORKS •

Please Write for bulletin EW4487

EISENWERK WUELFEL · HANNOVER-WUELFEL · GERMANY

Outlook for *Middle East Operations* Improves

RE-OPENING OF the Haifa refinery and further progress in planning the pipe line from the Kirkuk fields to the Syrian coast contribute to a new optimism concerning the future of Middle East oil.

VENEZUELAN crude oil has been imported into Palestine to re-open the Haifa plant of Consolidated Refineries, Ltd. The first shipment of Shell crude from South America reached Haifa early in September in response to an Israeli demand that the plant be put back in operation immediately or taken over by the Israeli government.

Meanwhile, oil company representatives and Israeli and Arab officials conferred on a solution of the difficulty which has kept the Haifa plant closed for more than one year. The Iraq government cut off the refinery's principal source of crude by closing the south leg of the Iraq Petroleum Company's pipe line from the Kirkuk fields. Shell, part owner of Consolidated Refineries, made its first shipment of Venezuelan crude as evidence of the company's willingness to cooperate with the Israelis; and Anglo-Iranian Oil Company, half-owner of the Haifa plant, has declared its readiness to tanker crude cargoes from the Persian Gulf to Haifa.

The Haifa refinery has a current throughput capacity of about 90,000 barrels a day. According to some reports the Israelis were given the right to purchase the Venezuelan crude at the low Mexican Gulf price plus transportation costs. In addition, contracts have been reportedly made by Shell and Socony-Vacuum Oil Company to supply refined products to the Israeli government at low cost as a means of relieving the dollar drain of Israel.

Meantime, Iraq Petroleum Company further advanced its plan for a 30-inch pipe line from the Kirkuk fields straight to the Syrian coast. This new line would be in addition to the double 16-inch line just being completed and paralleling the original 12-inch system from Kirkuk, forking at Haditha on the Euphrates, one leg running to Haifa and the other to Tripoli, Lebanon. IPC has applied to the Syrian government for permission to lay the 30-inch line with terminal at Banyas on the Syrian Coast. The proposed line would follow the present right-of-way to Homs, Syria, and thence cut directly to Banyas. The Syrians are reportedly in favor of the line because of the refinery that would be built at the terminal, thus making Banyas the chief sea outlet for Iraq.

IPC has completed all but 50 miles of the south leg of its new 16-inch line to Haifa, but it is rumored that this line may never be finished because of political difficulties with Palestine, and the line may even be tied into the 30-inch cross-Syria project at the Haditha pump station.

IPC has placed in operation the north leg of the new 16-inch line from Kirkuk to Tripoli and is now delivering 40,000 barrels a day. By the first of the year the Tripoli outlet will be receiving 90,000 barrels daily from this line plus another 40,000 barrels a day from the old 12-inch line. The increased production from the Kirkuk field was part of the stipulation settling the "Red Line Agreement" dispute last year, because the French are almost wholly dependent on the IPC outlet for their crude imports.

Iraq Opposes Line

Iraq has recently expressed concern lest her own petroleum resources be neglected in favor of Iranian and Persian Gulf crude. For this reason Iraqi are opposed to the construction of the joint British-American Middle East Pipe Lines, Ltd., a project which would carry in excess of 500,000 barrels a day from the Persian Gulf fields to the Eastern Mediterranean.

The Middle East Pipe Lines project is still not beyond the planning stage, although a convention for transit rights had been signed by the sponsoring companies—Anglo-Iranian, Standard Oil Company (N. J.) and Socony-Vacuum—with the former Syrian President Husni Zayim, later assassinated. Middle East indicated it would terminate its giant 32-inch line at Tartous on the Syrian coast and would construct a refinery there. The Iraqis definitely are striving to spur completion of the IPC line first because present lack of pipe line facilities are blamed for the limited development of the Kirkuk-Mosul fields. Iraq officials have said that despite Iraq's advantage in having great oil fields half the distance to the Mediterranean as compared with the Persian Gulf fields, greatest effort has been made to develop the Persian Gulf reserves. Iraq is hinging in immediate industrialization program on revenues derived from petroleum development.

An interesting arrangement by which American companies may operate profitably in dollar-short areas is afforded in the recent agreement by which Standard Oil (N. J.) and Socony-Vacuum will purchase from Anglo-Iranian large volumes of crude for "sterling" payment. This purchase agreement, first signed in September, 1947, was recently revived and in its present form provides for the two American companies buying 1300 million barrels of crude oil from Anglo-Iranian's Iran and Kuwait production over the next 20 years. All payment will be in British pounds unless the oil is shipped to a country that is able to repay in dollars.

The purchase agreement starts January 1, 1952, but the American companies have the right to cancel at the end of 10 or 15 years on five years prior notice. The deal is also subject to termination in case the Middle East Pipe Lines project fails to materialize. Jersey Standard itself will take 800 million barrels of A-I's crude over the 20-year period at a price which varies on the basis of A-I's costs. Jersey Standard owns a 24.7 percent stock interest in Middle East Pipe Lines, which intends to supply eventually the bulk of the crude deliveries. The agreement now provides that the three shareholders of Middle East Pipe Lines, Ltd., if certain construction conditions have not been met, will review the pipe line project at the end of 1956 and again at the end of 1961. If on either of these reviews, at least two of the shareholders do not agree that the line will proceed, the pipe line agreement will terminate and the deliveries of crude will terminate five years thereafter. If construction of the line is not "substantially" commenced by 1966, the pipe line agreement will terminate automatically, but such termination will not affect the crude supply purchase agreement.

Japan May Import *Sterling Crude* On U. S. Ships

By HENRY OZANNE, Eastern District Editor

THE important Japanese petroleum market may be reduced—or lost—to American companies because of a plan being worked out for the importation of sterling crude into Japan and the processing of the oil in Japanese refineries.

Japan conceived the plan of going on sterling crude in order to utilize its sterling accounts, which have been built up to the equivalent of $36 million in the sterling bloc. The oil deal is understood to be approved by MacArthur's Headquarters and by the Supreme Command of the Allied Powers (SCAP).

Before the war American companies supplied 75 percent of Japan's oil, and at the present time are supplying 66 percent of the 32,000 barrels a day of crude and products now being used this year in the islands. Japan's requirements for 1950 are set at 46,000 barrels daily. Since the end of the war Japan's oil needs have been paid for out of the "Garioa" fund, appropriated by Congress. For the current year total expenditures will reach $495 million. SCAP believes that Japan's use of sterling oil will reduce the amount of financial aid she must receive from the U. S.

According to the present plan, the Japanese Ministry of International Transportation and Industry will shortly call for bids on the crude purchases. Unless some dollar-sterling convertibility provision is established, this will result in sterling crude moving into Japan to the amount of around 12 million barrels annually. One industry authority says "this will eventuate in the whole business winding up in the hands of the British."

At the present time Caltex and Standard-Vacuum Oil Company maintain petroleum distribution systems in Japan in connection with Japanese associates, and Tide Water Associated Oil Company and The Union Oil Company market there through local associates. Industry officials believe the American companies will not suffer real losses in business as long as SCAP remains functioning, but thereafter there is danger that American companies may be forced out of the Japanese market.

"It's just part of the same program of building up the British oil interests around the world," said one American company executive. "The Japanese crude deal reverses the historical trend and is a danger signal."

Two Cargoes Approved

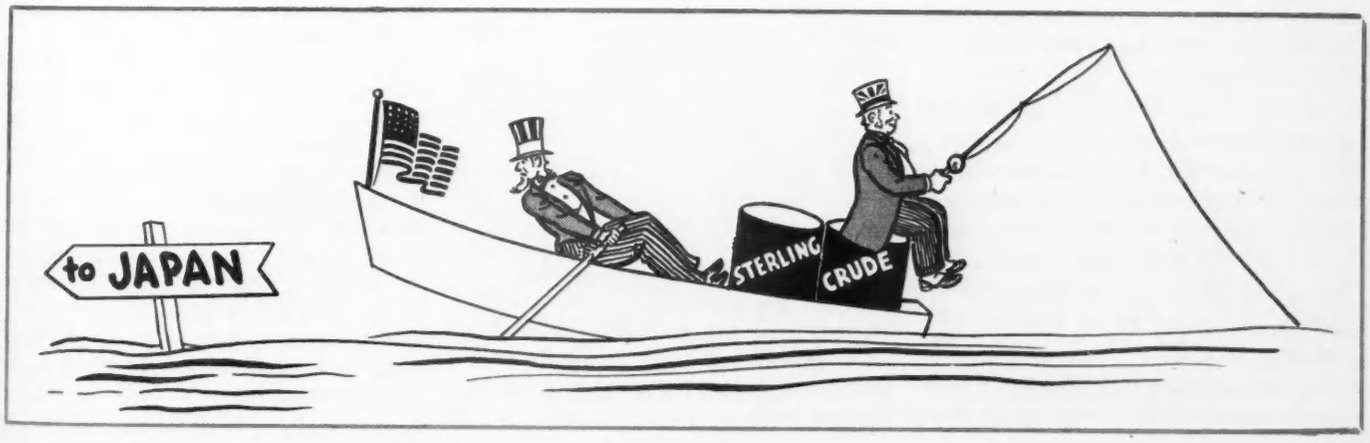
It is understood that bids for the crude purchases are pending settlement of efforts to use U. S. Navy tankers to haul the oil. There are about 14 Japanese tankers now in service between the islands and the Persian Gulf, all carrying product. Some of these ships could be converted to crude, but probably additional bottoms will be needed. That might give rise to the strange event of U. S. Navy craft carrying British oil to the Far East.

Importation of two cargoes has been approved definitely, and these will reach Japan later this year. The source of this oil is unknown, but it will be British, probably from the Middle East. Japan has scheduled imports of 480,000 barrels of crude imports for November, 240,000 barrels for December, and an additional 3.5 million barrels for the remainder of the fiscal year.

Japan is rebuilding her war-destroyed refining capacity rapidly, adding new equipment for the de-sulfurization of Middle East crude so that if necessary she can operate wholly on British oil. Peak wartime plant capacity in Japan was 110,000 barrels a day; hence it will be possible for Japan to process at home all the oil required for her domestic use.

Just how the crude import deal would work is not yet certain. Japanese refineries might handle the oil in processing deals for SCAP, which in turn would allocate out the product on the basis of the existing market structure. No private importation of crude is now allowed in Japan, so SCAP officials argue that American producers and exporters are not being hurt even if the whole importation is sterling oil.

However, industry economists point out the possibility that once the British suppliers become "dug in" through this kind of assistance, competition will increase against American companies in Japan as refining capacity catches up with demand.



U. S. Independents to Begin Operations in *Mexico*

By GEORGE O. IVES
International Editor

The International Editor of WORLD OIL recently returned from a visit to Mexico where he conferred with officials of Petroleos Mexicanos and visited scenes of current exploratory activity. In this and subsequent issues will be found observations on the progress and outlook of the industry on the part of Pemex and of private companies seeking to participate within the framework of Mexican law.

AT LEAST one of the two initial wells to be drilled in Mexico under the ten-well contract between Mexico's Petroleos Mexicanos and a group of American independent operators was to start actual drilling operations during October. This activity marks the first full-scale attempt since 1938 by Mexican authorities and by outside capital to get together on an arrangement whereby Mexico can avail itself of foreign capital and technical experience, with the outside operator having freedom of action in its exploratory activities within certain geographical regions.

Somewhat earlier, Petroleos Mexicanos had reached an agreement with Cities Service Oil Company which called for financial backing by the American company of wildcat operations within certain areas north of Tampico, but which did not allow the company to take part in the actual work. Currently two wildcats are drilling under this agreement, Pemex doing the drilling with its own crews, but expenses underwritten by Cities Service.

In the deal with the independent group, Pemex thinks it has found a formula whereby, in keeping with Mexican law, oil operations can be engaged in by the Mexican American Independent Company (CIMA), on a contractual basis and under the responsibility of Pemex, an agency of the Mexican government in charge of oil development. The three partners in CIMA are American Independent Oil Company de Mexico, S.A., (53⅓ percent), Signal Oil & Gas Company de Mexico, S.A., (33⅓ percent), and Edwin W. Pauley (13⅓ percent). Under the original agreement the three parties shared equal interests in CIMA, but recently American Independent has acquired an additional 20 percent from Pauley.

Modifications Desirable

With its many problems, not the least of which is the lack of funds with which to support indefinitely a full-scale exploration and development program, Pemex has turned to contracts such as that with CIMA in order to effect urgently needed exploration with expenses underwritten by the contracting firms. However, it seems that such a contract is not likely to prove popular with American contractors generally, one of the principal factors being the question of guarantees. It is generally thought in the American petroleum industry that no sound development program involving participation of American companies could be undertaken in Mexico until the latter's oil legislation is liberalized. Operators would not be averse to taking on contracts such as the one assumed by CIMA if such contracts were based on specifically enabling legislation. Such Mexican authorities as Antonio J. Bermudez, head of Pemex, have reiterated that no such modification will be made in Mexico's fundamental laws. Most spokesmen are firm in their stand that any attempt at modification might result in what may be construed as a giving up of part of their sovereignty of the sub-soil.

There is at present no question as to the intent of the contracting parties to respect the terms of the current agreements. No doubt has been expressed as to the intent of Pemex to respect the letter of the contracts, but some discussion has been heard as to whether the agreements would stand up in the face of possible attacks by an unsympathetic or unfriendly administration which may be in power at some later date.

At any rate, CIMA is going ahead with its program for exploration of the territory assigned to it under its current contracts. Within a short time it should have two rigs testing prospects in the Isthmus of Tehuantepec region. The first of these is to be a test of an offshore geophysical prospect at Tortuguero in the Gulf of Mexico, although directionally drilled from a location on the beach, and the second is to be at Xicalango in the State of Campeche. In general, the agreement calls for drilling seven off-

■ CONTINUED ON PAGE 237

The Brazilian Oil Picture

THE recent visit to the U. S. of President Dutra of Brazil may have a salutary effect on the Brazilian oil outlook by putting a check on ultra-nationalists in the Brazilian Congress who have fought a liberal oil development program which would permit foreign capital to participate with Brazilians in the development of that country's potential oil resources.

A change is undoubtedly in order if Brazil, with an area slightly larger than that of the U. S. and with more than 42 million population, is to become anywhere near self-sufficient insofar as oil economy is concerned. Although experts believe that at least one-third of the country's vast area has petroliferous possibilities, only an infinitesimal fraction of the likely areas have been explored. Unsympathetic laws, and fear of "Yankee" imperialism—the sort that pervades thinking in many Latin-American countries where oil is concerned—undoubtedly will keep Brazil in a distinctly inferior position petroleum-wise. Unfortunately, although Communism as a political movement has been outlawed in that country, the Communists are still a powerful factor in Brazilian politics and have had the major share in discouraging enactment of liberal petroleum laws favoring foreign capital without which Brazil cannot hope, within the foreseeable future, to develop her oil resources.

Brazilian experts who have recently visited the U. S. frankly admit that the petroleum situation in their country is likely to deteriorate rather than improve until such time as the Brazilian Congress enacts legislation which will attract foreign technicians and capital. Insofar as petroleum matters are concerned, they admit there is a strong anti-American sentiment prevalent in Brazil but hope the recent visit to the U. S. of the Brazilian president may help to overcome such prejudices and bring about a realignment among political factions so as to initiate the much-needed development program.

Political elements in Brazil who favor participation of foreign capital in the development of oil resources point to the success achieved in Venezuela and to the strong financial position of that government which has followed a liberal petroleum policy towards American and foreign oil companies. They are confident that Brazil, when it opens its doors to American oil men, will achieve as great a success as has Venezuela in the development of its oil resources.

Retain Imports Curbs

Jose Garrido-Torres, director of Brazil's Trade Bureau in the U. S., explains that the South American nation will retain restrictions on imports but that these curbs "will become tighter or looser in line with exchange availability until the influx of dollars into Brazil through bigger investments and U. S. purchases make restrictions unnecessary." He said that greater U. S. investments in Brazil and increased Brazilian exports to the U. S. offer the fundamental solution to the problem of Brazil's unfavorable balance of trade.

Brazil has indicated that it may allow foreign companies to participate in its petroleum development program, but the bill now before the legislative body carries restrictive provisions rather unattractive to American operators. The law, if enacted would:

1. Require foreign producing companies to hold reserve stocks of crude in Brazil three times the amount of the nation's annual consumption.
2. Limit all refining and transportation of oil to Brazilian companies.
3. Permit export of surplus oil only after the country's domestic needs are wholly supplied, and limit the marketing of petroleum within the country to Brazilian companies.
4. Require foreign companies operating in Brazil to contribute 10 to 14 percent of the value of their production to a National Petroleum Fund.
5. Limit concession terms to 40 years, with all assets invested then to be turned over to the state.

Other provisions of the proposed legislation fail to win favor with U. S. oil men. Among these are clauses such as the one providing that, although the concession term might be for a period of 40 years, all exploration agreements would be subject to review by the Brazilian government at the end of a five-year period, at which time the government can decide whether the private company can go further on the concession. Another

provision says that the foreign private ownership of petroleum transportation and refining facilities would be limited to 40 percent, although 100 percent foreign ownership in production facilities would be allowed. This would constrict the freedom of operation which makes for efficiency, and the five-year clause indicates there is no guarantee that a company would be allowed to produce any oil it finds.

With the publication of Decree 395 on April 29, 1938, since which time it has not been legally possible for foreign capital to participate in any way in either producing or refining projects, one American company found itself with a refinery it couldn't use. Early that year, in the absence of either prohibitory or enabling legislation, but with a license from the municipality of Sao Paulo, Standard Oil Company's Brazilian subsidiary completed a small refinery in that city. Just as it was ready to go on stream Decree 395 was enacted. As a result the plant was never operated and eventually was dismantled. The land was sold and new land bought for a large bulk plant and terminal at São Paulo which has been in operation for the past three years. Distribution of refined products was not prohibited under the decree.

Many petroleum equipment suppliers are highly interested in the trip to the U. S. of Brazil's financial minister Castro at the time when Brazilian officials are trying to work out with the U. S. and with American exporters a solution for the payment of $120 million in unpaid export balances as well as a $40 million gold loan balance in the New York Federal Reserve Bank, the security for which is the backing of Brazil's currency.

The joint Brazil-U. S. Technical Commission reported earlier this year that fast exploration of Brazil's oil possibilities is essential to its economic development. The report urged that the laws be amended so as to attract foreign oil capital, and pointed out that Brazil now has inadequate supplies of fuel and power for her industrialization program. It further pointed out: "The consumption of petroleum products is likely to be ever increasing—along with and as a condition of—Brazil's further economic development. There are large areas in Brazil where there are promising indications that petroleum exists. Present development programs for transportation and industry assume the continued and increasing availability of petroleum supplies. Yet the resources being devoted to exploration work by Brazil are far from sufficient for an intensive exploration plan."

The Conselho Nacional do Petróleo, government agency which operates Brazil's oil business, estimates that it has a total daily productive capacity from all wells of 10,000 barrels. However, the agency points out that this is based on full flow of all wells without regard to efficient production methods and that, in effect, the actual potential of the country is between one-half and one-third of the estimated 10,000 barrels daily.

History of Industry

A thumbnail picture of Brazil's oil developments, given below, indicates the effects of government control in oil matters and the inertia that results from a "closed door" policy barring foreign enterprise and capital.

Commercial oil was first discovered in Brazil in 1939 in the vicinity of Lobato, state of Bahia. Since then, exploration work and drilling has been undertaken in various parts of Brazil, particularly in the Reconcavo area. The reserves established in these fields, though small, justified the installation of a small topping plant whose products are used in the vicinity. It is here that all current productive capacity is concentrated, and it is felt that if Brazil is to solve its petroleum problems it must intensify its search, not only in these areas, but in other regions where conditions are favorable for oil occurrence. The Conselho has, on a small scale, been doing geological and geophysical work as well as some aerial mapping in outlying areas and is making some progress in insulating the more likely localities for more detailed exploration. At the moment most of the work is being done in the following places: The Maranhão-Piauí basin, the northern part of the State of Goias, the eastern and northeastern coastal regions extending from Rio Grande do Norte to Espiritu Santo which includes the Reconcavo basin and part of the Parana Basin.

These operations are being gradually intensified and supplemented by the drilling of stratigraphic tests and the correlation of the various wells by electrical logging profiles, as well as through petrographic determinations. Geophysical work includes the operation of both seismograph and gravity meter equipment, currently under way on the island of Marajó and in the central part of the State of Sergipe. Similar work has already been done at Reconcavo and in the region of Ponta Grossa in the State of Parana. While the work is under the supervision of the Conselho Nacional do Petróleo, many of the actual operations are being done by American geophysical companies under contract to the Conselho. Other such work is being carried on by Brazilian engineers and geologists working out of regional offices established in the States of Pará, Maranhão, Sergipe, Bahia and Parana.

Since the creation of the Conselho in 1938, there were only 148 wells drilled in the state of Bahia up to the end of 1948, and seven wildcat dry holes in the state of Alagôas. This represents but a small percentage of the number of wells likely to be required to prospect adequately Brazil's tremendous area. Most of the wells have been drilled in the producing areas of the Candeias, Lobato-Joanes, Aratu, Itaparica and Dom João fields, but a few have been actual wildcats. A feature of 1948 was the drilling of two deep wildcats, at Santo Antonio to 9088 feet, and at Tucano to 5758 feet. Both were dry.

Although most of the wells have been drilled in the Candeias field, and consequently it is here that most of the productive capacity is concentrated, much hope is felt for the Dom João field, discovered in 1947, which produces lighter oil than the other areas, and from depths less than 1000 feet.

Total reserves in the Bahia fields are estimated at approximately 18 million barrels of oil and perhaps 43 billion cubic feet of gas. Total accumulative production to the end of April was 567,503 barrels. This production has been used only for drilling fuel, and after topping in a small plant at Aratu, as products for local consumption, and represents only a small portion of the productive capacity. As previously indicated, the estimated potential of 10,000 barrels daily would be materially less under production conditions due to the low per-well potential and to the high paraffin content of the crude which would necessitate frequent workovers.

The market for gas is limited to field use and to several small industries in the immediate area. Since 1947 an effort has been made by the Conselho to promote the use of gas in other industries in Bahia, which is notably short of energy, but without much success. Pipe lines and other installations are lacking, but it is thought that should private enterprise be permitted to take part in this development, a large market for American manufactured products for home and industry would be created.

Brazil has only three relatively small refineries operating and most of its requirements must come in the form of refined products. One plant in Rio Grande do Sul has a capacity of 1000 barrels daily, and there is a 1000-barrel plant at São Paulo. A new plant now being built in the Candeias area by the Conselho will handle 2500 barrels daily with complete cracking facilities to augment the present 150-barrel unit, and two larger plants have been authorized. One of these, with a capacity of 20,000 barrels daily, will be obtained from

Czechoslovakia for erection in the São Paulo area, while the other is to be obtained from France, and will be built in the Federal District near Rio de Janiero. The latter was originally scheduled to have a capacity of 10,000 barrels daily, but recent reports say it may be enlarged to as much as 45,000 barrels by the time of completion. Both are to operate on imported crude. The federal government is anxious to attract private capital for the refining industry, if not for exploration, and also hopes to use part of its revenues from the proposed government-sponsored refining projects to pay for exploitation work in present producing areas.

In 1946 the Conselho established a commission to conduct a study of the need for pipe lines to transport crude and refined products from the port of Santos to the heavily industrialized city of São Paulo. As a result, two pipe lines have now been built which are capable of moving products in either direction between the two points. The lines are 28.7 miles long. One is an 18-inch fuel oil line having ultimate capacity of 40,000 barrels daily, and the other a 10-inch line for light products with a capacity of 28,000 barrels daily. The pipe lines have the added advantage of replacing rail transport which in this part of the country is incommodious and dangerous. At the same time it releases more than 400 tank cars which can be used for transportation in other zones lacking pipe line facilities, especially in the central part of Brazil.

U. S. Oil Men In Mexico

■ CONTINUED FROM PAGE 234

shore prospects within a prescribed area, and three land prospects in the same general region. The company acts as operator, with the privilege of exploring for prospects through geophysical or other methods. It conducts all operations at its own expense until such time as oil may be found on one of the prospects. In case it finds oil it is entitled to recover the expense of finding it from 50 percent of the first produced, and as compensation is entitled to a profit amounting to an additional 15 to 18¼ percent of the oil. If no oil is found the company is out its expenses incurred during the search. All producing operations are to be carried on by Pemex.

Actually the agreement is in the form of two separate contracts, one covering the seven prospects it may select in an offshore strip five kilometers (3.1 miles) wide extending from a point just west of the city of Coatzacoalcos to a point just east of the town of Carmen, or roughly 235 miles along the coastline. The other contract covers the selection of three prospects on land, but with considerable latitude as to the geographical area in which the prospects may be situated. Reimbursement for expenses will be out of 50 percent of the discovered oil in both cases, but the amount to be allowed as compensation will be 15 percent from land prospects, whereas the higher rate of 18¼ percent will be allowed on water structures because of the greater operational difficulties involved. Another feature is that recovery of expenses is an integral part of each contract separately. In other words, expenses incurred in drilling land structures cannot be recovered out of oil which may be produced from discovered offshore fields.

Two geophysical crews are being maintained in the area by CIMA, with work being done offshore as well as on land. It is said that conditions are quite favorable for such offshore work, with very few periods during which work must be suspended because of weather or water conditions. Also, there are very few spots within the area under investigation where the water is too deep for drilling operations. Some latitude has been given in the contract for fields which may lie partly within and partly without the five-kilometer limit. The company's benefits would include the entire structure in such cases.

Peninsula Site

Strangely enough, although the first well is to test what has been agreed upon as an offshore structure, the entire rig will be set upon land, and the second well, which is to test a land structure, will be reached by water, and will be drilled by a rig set on pilings driven through water. The first, known as Tortuguero 1, is to test a dome-type structure situated in the saline basin of the Isthmus of Tehuantepec, six miles west of the town of Tonalá and just high enough on the beach to be beyond the reach of high tide. At this spot the well will be about 12½ miles east of the town of Coatzacoalcos.

The second well, Xicalango 1, will be drilled on a peninsula about ten miles west of Ciudad Carmen, with the rig and other materials to be brought in on a converted Navy LCT through a lagoon and along a canal now being dredged. The terrain dictates the type of drilling structure used, and the rig will be built on piling, although the operation itself is classified as a land prospect, the first of three to be drilled under that part of the contract. Present information indicates none of the depths will be excessive, and most of the formations to be tested will be reached within 6000 to 9000 feet.

Kerr-McGee Oil Industries, Inc., will act as drilling contractors, working for CIMA, and drilling equipment was assembled in Houston before being transported to the base of operations.

In selecting prospects for land drilling, CIMA has the right to pick structures previously outlined by Pemex geological and geophysical work, but in the case of the water structures it is necessary for the operators to do their own work in the absence of existing detailed information. The land prospects can be picked by mutual agreement out of certain areas which include regions in Vera Cruz, Tabasco and Campeche, and some work is now being done in all of these localities. A considerable amount of preliminary exploratory work has been done in the Isthmus by Pemex and the companies operating in the area prior to 1938, and the results of such geological and geophysical work have been made available to CIMA. In recent years Pemex has covered approximately 10,000 square miles in the Isthmus with core drill, geological and geophysical work.

It can be readily understood why the first activity should be at points along the coastline. The Isthmus is covered for the most part with tropical rain forest, and almost any area in the interior would multiply operational costs, since few lines of communication exist. Outside the salt dome basin, roads passable in all weather are almost non-existent, and building roads capable of supplying an oil operation would entail great expenditure of time and money. Almost all of the wildcat operations in the area are so situated that they can be reached only by air or by river transportation. In only a few instances are the rivers navigable throughout the year, and air strips capable of handling heavy, freight-carrying aircraft are rare. The salt dome basin, wherein are located almost all the present producing oil fields, has been the scene of operations for more than 25 years. During this time roads to the principal fields have been constructed, but to the eastward into Tabasco and Campeche most areas of activity cannot be reached by highway or railroad. The CIMA organization has set up regional headquarters in Coatzacoalcos where supervisory personnel will be stationed and where material will be received, but some installations will also be maintained near the present well sites.

Exploration in Germany Meets With Increasing Success

EXPLORATORY drilling in Germany, intensified since the end of the war, has met with better success this year than in the period 1945-1948. A number of new areas had been brought into production during those years, but, with the exception of favorable expansion of several fields in the Emsland, no important oil discoveries were made.

This year, however, results have been much more encouraging. Perhaps the most important new field since the close of the war was opened earlier this year at Ruehlertwist, also in the Emsland near the Dutch border. Subsequent drilling expanded the limits of this field and established production in more than one horizon. Information from Germany indicates the field has already been proven as a reserve of more than 25 million barrels, although in only the preliminary stages of development. The most recent extension of production was in completion of Ruehlermoor 1, several miles east of Ruehlertwist production, but thought to be part of the same feature. This latest well was completed with flowing output of approximately 150 barrels daily from the Bentheim sandstone at 2085-155 feet. Prior to completion in this horizon the well had made tests of the Dichotomiten sandstone which indicated it should produce from that pay as well.

On August 10 another field was brought into production with completion of Suderbruch 1, a wildcat in Lower Saxony near Schwarmstedt in the Hanover region. Drilled by the Gewerkschaft Brigitta-Deutsche Vacuum Oel interests (Standard Oil Company [N.J.], Shell and Socony-Vacuum Oil Company), the well found a 46-foot section of oil sand at a depth of 6757 feet, and was completed at total depth of 7068 feet as the deepest producing oil well in northwest Germany. Of particular interest is that it was drilled on a so-called intermediate structure and will doubtless give rise to considerable additional work on such structures throughout the region.

On production test the well flowed through a small choke at the rate of 240 barrels a day, light oil with gas-oil ratio approximately 150-1.

More recently the discovery of an oil field near Hamburg has been indicated through tests in a wildcat drilled in the Hohenhorn area, east of Hamburg and about three miles southwest of Schwarzenbek. Hohenhorn 12 is on a salt dome prospect where a number of wells have been drilled over a period of several years, a few of which showed traces of oil. The current well is the first to show indications of commercial production. Its importance is minimized, however, by the character of the oil, which would not seem to lend itself to normal refining processes as well as other production in the area. Initial tests resulted in recovery of from 20 to 45 barrels daily of heavy oil with relatively high sulfur content. Production is coming from two sandstone strata at 2633-49 and 2729-40 feet, believed to be part of the Lower Dogger Jurassic formation.

Exploration Plans

Currently about one-third of the footage drilled in northwest Germany and Badonia is of exploratory nature, not including that drilled in extension tests, and the entire program is being planned with a view to continuing this wildcat activity. New drilling equipment is to be made available shortly through the approval of Marshall Plan allotments amounting to a million dollars for machinery. At the same time preliminary work remains active with 15 geophysical crews working in northwest Germany. Some of this work has been carried out since June in the tidelands area of the North Sea in the Duhnen-Neuwerk-Schaarhoern region, attempting to outline a structure believed to exist as part of the Heide-Meldorf group of fields. Before the war a structure at Cuxhaven had been roughly outlined by refraction seismograph work as being connected to the Heide group which have produced from good accumulations in Tertiary beds on the west flanks. Although seven wells have been drilled on the Cuxhaven prospect, it is believed that all of them were either on the crest or on the east flank of the geologic high. Some showings of oil were found, but not in commercial quantities. The current problem is whether the west flank, extending almost parallel to the coast offshore between Cuxhaven and the Island of Neuwerk will show accumulations such as on the west flank of the Heide fields. Preliminary work of the current survey indicates a plunge of the Tertiary base down to about 4300 feet in the west, with the conclusion that there exist thick Tertiary beds such as found at Heide.

Pakistan Discovery Clouded By Contradictory Reports

Speculation and mystery prevail over the result of recent drilling operations in Pakistan where an important discovery was reported last July. The discovery was the first by Burmah Oil Company (Pakistan Concession) Ltd., at Balkassar, West Punjab, and according to reports from Karachi the well was flowing in excess of 2000 barrels daily, on early tests.

The mystery deepened when Burmah Oil Company spokesmen in London denied the possibility of large production in Pakistan, but in so doing contradicted the company's Pakistan branch office, which had issued optimistic reports. One petroleum analyst wrote in the *Muslim Economist* of Lahore: "All information is being kept a closely guarded secret by Burmah Oil Company. But judging on details which we know, we conclude that shortly the test well will be one of the world's biggest. The daily production of this test well on July 3 went up to 1800 barrels daily from a little over 100 barrels daily on the first 24-hour test."

The initial well is said to have been brought in at about 8200 feet near Rawalpindi. Burmah Oil is continuing drilling in several other locations including Lakhra, Sind Province, where gas was found at about 5200 feet.

Attock Oil Company, the only other operator in Pakistan, produced about 560,000 barrels in 1948 from its three fields. Burmah Oil entered the Balkassar region a year ago and local experts judge this new field will produce 50 percent of Pakistan's annual petroleum requirements of 4 million barrels. Reserves also are indicated in East Pakistan, where Burmah Oil is now exploring. Geological reports have been especially favorable on the Mayamo belt near the East Pakistan Burma border, where there is an extension of the Akyab oil fields of Burma. This belt runs to Digboi in Assam.

Pakistan's own oil requirements are expected to rise sharply. Already a large percentage of locomotives on the Pakistan railways have been converted to diesel, and the country is relying heavily on oil to accomplish its industrialization program.

Pakistan officials have been talking about tightening the oil law which at present vests with the national government the right to grant oil concessions. A recent draft of the Pakistan Petroleum Production Rules sets forth conditions and terms of operations. The government would take a 12 percent royalty under present laws, but it has been proposed to increase this rate to as high as 20 percent.

COMPANY

EXCLUSIVE EXPORT DISTRIBUTOR
for EMSCO SLUSH PUMPS

Emsco Derrick & Equipment Company proudly announces the appointment of the Export Division of Mid-Continent Supply Company as EXCLUSIVE *export distributor for Emsco Slush Pumps. All export sales and service inquiries on Emsco Slush Pumps should be directed to Export Division, Mid-Continent Supply Company, 42 Broadway, New York City, New York, U.S.A. Mid-Continent Supply Company will also continue to handle Emsco Slush Pumps in Montana, Wyoming, Colorado, Louisiana, Arkansas, New Mexico, Illinois, Texas, Kansas, Oklahoma, Mississippi, Kentucky, Indiana and Nebraska on a* NON-EXCLUSIVE *basis.*

ADV.—42-49

EMSCO DERRICK & EQUIPMENT COMPANY

HOUSTON, TEXAS • LOS ANGELES, CALIFORNIA • GARLAND, TEXAS

Exclusive Export Distributor for Emsco Slush Pumps

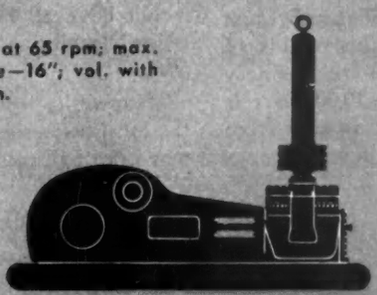
MID-CONTINENT SUPPLY COMPANY, EXPORT DIVISION, 42 Broadway, New York City, New York • *Offices:* Los Angeles • Houston • New Orleans • San Antonio Fort Worth • Dallas • Tulsa • Caracas, Venezuela • Bogota, Colombia

General Offices: Mid-Continent Building, Forth Worth, Texas

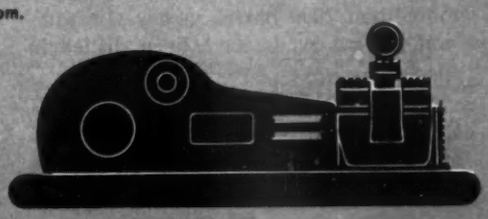
EMSCO

REG. U.S. PAT. OFF.

D-500: Hp. input—500 at 65 rpm; max. size liners—7½"; stroke—16"; vol. with max. size liners—751 gpm.



D-850: Hp. input—850 at 60 rpm; max. size liners—8¼"; stroke—18"; vol. with max. size liners—933 gpm.



Market Demand Increasing For Alberta's Light Oils

PRODUCERS of light oils in Alberta were encouraged in September when British American Oil Company disclosed that arrangements have been made for the purchase of oil from Canadian Gulf Oil Company's new discovery near Stettler, heretofore shut in for lack of a market outlet. Also, Imperial Pipe Line Company, Ltd., as principal purchaser in Northern Alberta, announced a second increase in daily allowables, or pipe line acceptances, representing increased amounts of oil which will be purchased from wells in the Leduc, Woodbend, and Redwater fields. Some producers would not have been surprised if the announcement had related to a reduction, rather than an increase, in consequence of the continued drilling and completion of many new wells, all entitled to share pro-rata in the available market demand.

Gulf will begin construction at once on a 1½-mile gathering line joining the Canadian National Railways, where oil will be loaded into tank cars for shipment to British American refineries at Calgary and Moose Jaw. While the area of the new oil field about eight miles south of Stettler and 50 miles east of Red Deer, a midway point on the Calgary and Edmonton highway, would appear to be limited by dry holes heretofore drilled in the general vicinity, it is in other respects similar to the Leduc field, in that production is found in two zones of the Devonian lime at total depth in excess of 5000 feet. The discovery well is said to have a potential of around 3000 barrels of light oil per day. Meanwhile, Gulf is approaching the pay zones in a second test and is about ready to commence drilling in another wildcat about 25 miles southwest of the Ellis discovery well.

The new "allowables" established by Imperial Pipe Line Company, Ltd., effective September 1, are as follows:

Field	Pipe Line Acceptances	Increase Bbls/Day
Redwater	135	10
Leduc-Woodbend		
D-2 Zone	80	7
D-3 Zone	115	10
Lower Cretaceous Sand	80	5
Golden Spike	325	25

As nearly 500 wells are involved, this means that, if British American should follow suit in regard to wells to which it is connected, producers in the Edmonton district will be afforded market outlets for nearly 5000 barrels of oil per day, which will bolster their gross incomes by $13,000 or $14,000 per day, in the aggregate.

Insofar as Imperial Pipe Line is concerned, these increases are based on an improvement in available storage, resulting from a 41 percent increase in the throughput capacity of Imperial Oil's new refinery at Edmonton, where construction has never been stopped since it was moved from Whitehorse, in the Yukon, and which is now rated at 21,500 barrels per day, and on the restoration of refining facilities damaged by fire in the Imperial Oil plant at Regina, Saskatchewan, which can handle up to a maximum of 17,000 barrels of Alberta crude per day. These supplies are transported by rail from the flush fields of Northern Alberta. Imperial Oil's refinery at Calgary is using 8000 to 10,000 barrels per day, which is supplied in part from the old field at Turner Valley.

While accessible refining capacity is the bottleneck limiting the production and marketing of crude in Western Canada, it happens that the harvest season now in progress will mark the year's peak of consumer demand.

These added and rebuilt facilities at Edmonton and Regina, which bring Imperial Oil's prairies refining capacity up to a new total approaching 50,000 barrels per day of maximum throughput, will go a long way toward closing the gap between total refinery output and total consumer demand for finished petroleum products in the prairie markets, as defined by limiting freight rates, mountains, muskeg, etc. Another plant being planned for Edmonton might almost close this gap, temporarily, at least; but, at present, there is still a substantial shortage of finished products in the three prairie provinces, which demand is covered by imports from Eastern Canada and the U. S.

Imperial Oil Limited is building a $3½ million plant for the extraction of natural gasoline from gas now being flared at Leduc; and Irving B. Chittenden and associates of Los Angeles have announced plans for the construction of a smaller plant to process wet gas produced from the Hanna field. So far as is publicly known, no independent refineries have been planned or proposed, as there are virtually no independent marketing channels in Western Canada.

Early 1950 Completion Goal Set for New Chile Pipe Line

Construction began late in September on Chile's oil pipe line from the Cerro Manantiales (Springhill) field to Caleta Clarencía (Clarence Cove) on Tierra del Fuego. The line will be 43 miles long and will run in a southwesterly direction toward the Straits of Magellan. About 3000 tons of pipe will be required for the project, which will be an eight-inch line of 10,000 barrels daily throughput capacity. The line is scheduled to be put in operation by the first of 1950.

During August and September tankage was erected for the new line. One 50,000-barrel tank has been put up at the field, another 80,000-barrel tank at the terminal, and a third 55,000 barrel tank there is under construction. Later two other 55,000-barrel tanks will complete the storage installations.

The new line will handle the entire output of Cerro Manantiales field. A 3300-foot 16-inch submarine loading line will allow tanker loading at the Strait for up-coast movement. At first Chile plans to export all the field's production in order to obtain funds to finance construction of a refinery at Concordia. On completion of this plant, oil exports will be suspended and the total production will be refined in Chile.

Cerro Manantiales field now has 12 oil producers capable of a daily output of more than 2000 barrels a day. In addition six gas wells have been drilled in the field.

Egyptian Crude Export Agreement Is Deadlocked

In spite of previous optimistic reports of an impending agreement to end the Egyptian deadlock, it is now reported that the Egyptian government has refused to exempt the Standard Oil Company of Egypt from the Mines and Quarry Law in such a way that the company could export 7 to 10 percent of its crude oil production to be refined abroad. Mustapha Maher Bey, assistant undersecretary for Industrial Affairs, has announced that the Ministry has not and will not modify the law concerning mines and quarries.

American oil companies are reported to be trying to persuade the Egyptian government to confine the right to ban exports of crude oil only to such time as local production is below the country's existing refinery capacity. When production is in excess, they suggest, the surplus should be exported for refining abroad. This would insure that Egypt would have all her requirements of oil refined locally and also benefit from exports.

Meanwhile, work on the expansion of the local refineries and plans to establish new ones will continue.

*

EVERY TANK . . . EVERY TIME WITH *Visco*

THE CONSISTENTLY EFFICIENT EMULSION BREAKER

Call Houston, CAPITOL 7300, collect, for fast action on your emulsion-breaking problems.

VISCO PRODUCTS COMPANY
INCORPORATED
City National Bank Building
Houston 1, Texas

Visco

DEHYDRATING AND DESALTING CHEMICALS ● WHEREVER COST AND EFFICIENCY COUNT

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating compounds for use in the breaking and resolving of oil emulsions, and to grant licenses for such use, under the following United States patents: 1,860,562; 1,860,563; 1,912,330; 1,927,259; 2,050,639; 2,050,640; 2,206,589; 2,214,783; 2,214,784; 2,225,189; 2,303,414; 2,307,813; 2,318,034; 2,318,035; 2,321,056; 2,335,554. Re. 20,717 and patents pending. Any purchaser of Visco Oil Treating compounds is authorized to use the same in the treating, breaking and resolving of oil emulsions in accordance with the above patents. The royalty for such use is included in the purchase price. Visco Products Company is authorized to and is willing to grant licenses on a royalty basis, to all companies, and to others desiring to practice the patented subject matter, under any and all of the above patents, permitting the user to purchase the oil treating compounds at will from any vendor, and to prepare the compounds for use under the above patent or patents, at a royalty charge of 20 cents per gallon. Application for license should be made to **Visco Products Company**, Houston, Texas.

Oil Men Investigate Rigs Available in Western Canada

The Western Canada Petroleum Association, a service organization whose membership is made up of men prominent in the oil industry of the Dominion, and which might be described as the counterpart of the Mid-Continent Oil & Gas Association, is conducting a poll of the situation as it exists in Alberta and Saskatchewan with respect to the number of drilling rigs available, in operation, shut down, etc. E. W. Kolb, secretary-treasurer of the association, would make no prediction in advance of the return of questionnaires outstanding, but he did say that when all have been returned and examined, the directors of the association probably would consider the advisability of making public their findings as to surplus drilling equipment, if any should appear.

Meanwhile, it is a matter of common report that more than 135 rotary rigs of various capacities are on hand, in operation, or "available" in the two provinces named above, of which 25 or 30 are now shut down in the active and productive areas around Edmonton.

Other contractors are coming in daily from the U. S. to investigate the possibility of finding employment for such equipment. It would appear, on an overall basis, that there are on hand and en route to Canada enough men and equipment to handle all the drilling which may need to be done during the interval which must elapse before the completion of the proposed trunk pipe line may be expected to give relief to producers who now are unable to find markets for the greater portion of their potential output.

Footage rates recently were cut by $1 per foot to a new low of $5.50 in the 3000-foot field at Redwater, while rates ranging from $8.25 to $8.75 are said to rule in the deeper fields of Leduc and Woodbend, where production is from depths slightly below 5000 feet.

Routine drilling for production undoubtedly will be slowed down, as an inevitable consequence of the local oversupply of crude oil, but exploratory drilling is expected to be continued without abatement, following the recent announcement of the commencement of work for the construction of a pipe line outlet, and the enactment in July of legislation which could be administered so as to permit the export of gas beyond provincial boundaries. Also, there are many strong U. S. oil companies listed among the newcomers to the Canadian scene, who may be expected actively to explore large holdings of acreage so as to have become actual producers when the proposed new pipe line is completed two years hence. Also, the terms of prospecting licenses, in addition to the usual factors of intense competition, serve to some extent to force the hands of licensees who must meet time limits, etc., in matters pertaining to geological reconnaissance, geophysical prospecting, core-drilling, wildcat drilling, etc.

High Operating Costs Prevent U. S. Tanker Fleet Expansion

HIGHER operating costs of American tankers against those under foreign registry are preventing a further increase in the size of the American tanker fleet, it was brought out at a recent hearing before the sub-committee on Merchant Marine and Maritime Affairs of the Senate Committee on Interstate and Foreign Commerce. Millard B. Gamble, general manager of the marine operations department of Standard Oil Company (N. J.), explained the dilemma his company faces and one which is shared by other units of the petroleum industry.

Transportation costs of American flag tankers are about 25 percent higher than in the case of comparable foreign flag tankers, Gamble testified. He presented the data in Table 1 showing Jersey Standard's tanker position relative to the world total.

"The tanker fleet owned by Jersey and its affiliates is divided about equally, on the basis of carrying capacity, between ships of foreign registry and ships of U. S. registry. Jersey interests own a much larger percentage of American tanker requirements than of their foreign requirements. This is true in spite of that fact that our foreign tanker requirements are substantially in excess of our domestic requirements."

Despite the fact that Jersey Standard, like other oil companies, seeks to have as many of its tankers under American flag as it can, Gamble testified that in order to put under American flag the four new 26,000-ton tankers now being built for the company, an equivalent tonnage in T-2's would have to be transferred to foreign flag. The company, he said, is now covered 190 percent in U. S. flag tonnage of its domestic coastwise requirements, and will probably average 160 percent of coverage from now through 1950.

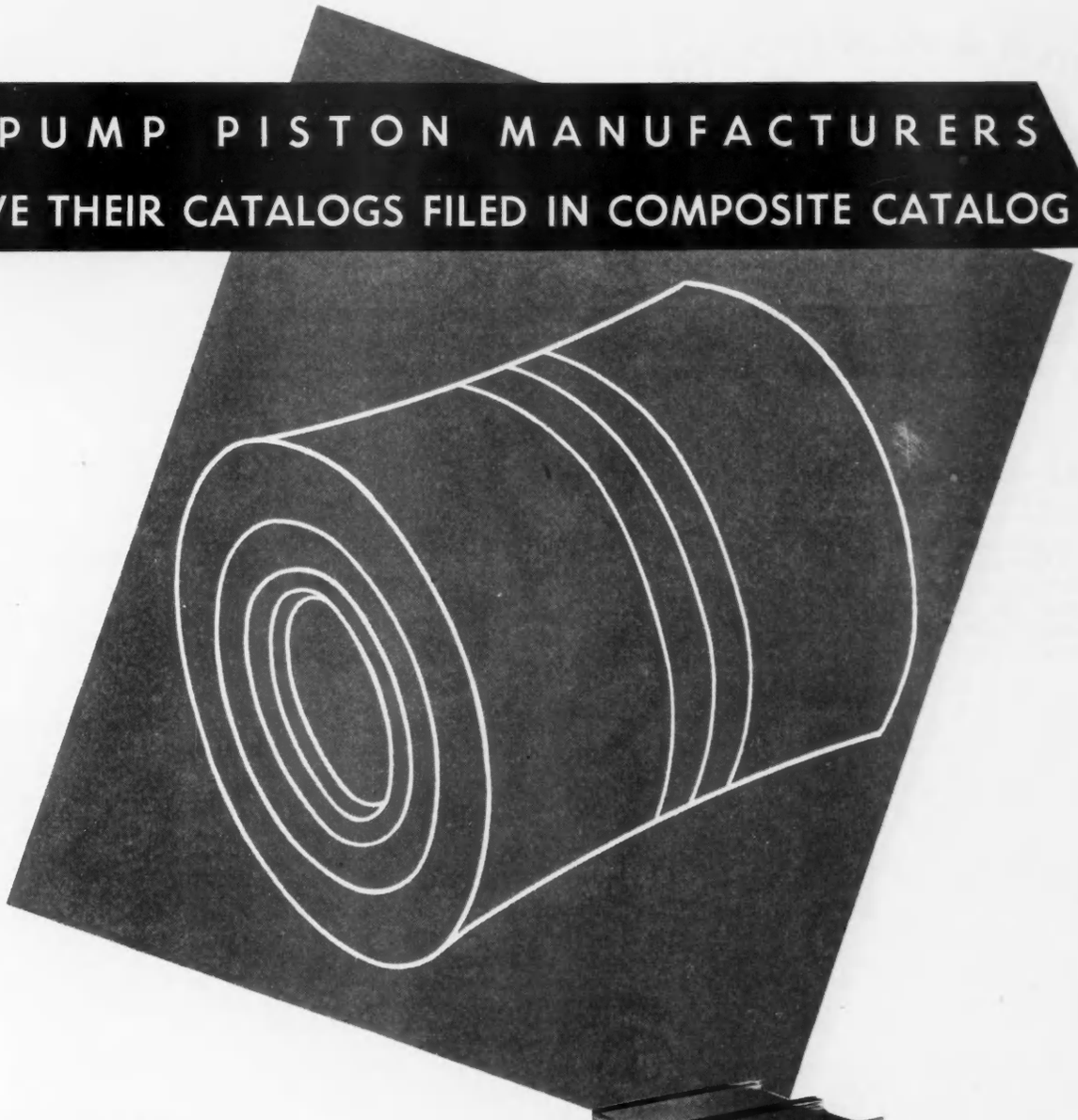
"Therefore," Gamble said, "we cannot jusitfy further additions to our American flag fleet at this time except by compensating transfers." He explains there is some advantage in placing the new super tankers under U. S. flag and the transfer of equivalent capacity to foreign flag because wages are a smaller component of the total transportation costs in the case of the larger vessels.

"The question might be raised as to why our company has any foreign flag fleet," Gamble said. "Jersey Standard and its affiliates operate tankers in practically all of the world trades, and we believe it to be to the best interests of our country for Americans to engage in foreign trade of various kinds. However, where such trade cannot be carried out on a competitive basis, one's business is short-lived. This is especially true in the tanker business where transportation costs under the American flag are approximately 25 percent above those of the foreign-flag competitor. In the tanker business, therefore, it is not a question of choosing between American and foreign-flag vessels for foreign business. The real choice is between the various foreign flags, of which Panama is one."

WORLD'S TANKERS	United States	Foreign	Total
Deadweight Tons	8,817,000	15,067,000	23,884,000
Number of Tankers	573	1,158	1,731
Number of T-2 Equivalent Tankers	525	778	1,303
TANKER FLEET OF S. O. CO. (N. J.) and AFFILIATES			
Deadweight Tons	897,000	1,033,000	1,930,000
Number of Tankers	54	65	119
Number of T-2 Equivalent Tankers	53	53	106
PERCENT OF S. O. CO. (N. J.) AND AFFILIATES FLEET TO WORLD TANKER FLEET			
Percent of S. O. (N. J.) and Affiliates Fleet to World Tanker Fleet	10.1	6.8	8.1

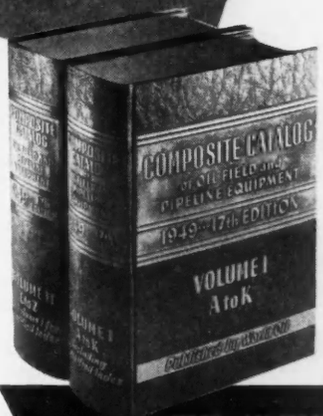
NOTE: Tankers under 6,000 D.W.T. excluded.

14 PUMP PISTON MANUFACTURERS HAVE THEIR CATALOGS FILED IN COMPOSITE CATALOG



EASIER TO COMPARE, EASIER TO ORDER

From bits and blocks to wrenches and yokes, whatever you buy for oil field or pipe line you'll save time, save money and eliminate errors in ordering when you look it up in Composite Catalog. Complete catalog data on 2980 types of equipment by 462 leading manufacturers is contained in the current edition, indexed for easy reference by product and company.



Published by World Oil

THE UNIVERSAL EQUIPMENT GUIDE FOR OIL COUNTRY BUYERS

COMPOSITE CATALOG

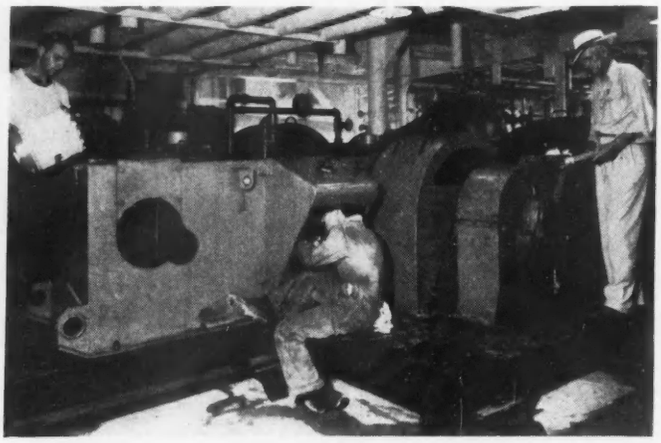
DESCRIPTIONS OF NEW EQUIPMENT IN THIS ISSUE OF WORLD OIL ARE SUPPLEMENTS TO THE MANUFACTURERS' PRE-FILED CATALOGS IN COMPOSITE CATALOG

NEW AND IMPROVED Equipment SUPPLEMENTING COMPOSITE CATALOG

New and improved equipment of manufacturers who describe their products or services in the current Composite Catalog

248—Dual Pump Drive

This item supplements Oil Well Supply Company data as shown on pages 3105 - 3252 of Composite Catalog.



Successful deep sea drilling depends considerably upon utilizing wherever possible equipment which will require the least amount of space without loss of operating efficiency. Designed for Magnolia Petroleum Company, a special dual pump drive has a width almost 30 percent less than that of most dual pump drives used in land drilling. The unit is in operation aboard a converted wartime YF Navy barge off the Louisiana coast.

The dual pump drive is narrow enough to fit between the bulkheads of the barge with adequate working space around the unit without sacrificing performance. The unit was designed with a minimum number of parts and with a view to easing the handling problems encountered in barge installation.

The No. 2 pump is driven by means of an extension from the No. 2 engine shaft through a jack shaft which is mounted on the same center as the shaft driving the No. 1 pump. Either pump may be driven independently at different speeds and either pump or both pumps may be driven by both engines.

The arrangement allows identical short center chain drives to the pumps. The design also permits setting the pumps side by side, adding to the over-all compactness of the unit and simplifying piping.

The additional shock stresses resulting from the use of chain drives instead of belt drives were offset by placing hydraulic couplings between the engines and the compound transmission to cushion shock loads in either direction between engines and pumps.

The transmission was designed to conform to the compactness of the entire unit. Compound chain and sprockets and all bearings in the compound case are oil bath lubricated. Lubrication is provided by three oil pumps—one to each of the pump chain drives and one in the transmission case.

Both pump drives are connected to the transmission through Fawick clutch couplings which allow all chains in the pump drives to remain stationary when the unit is not in operation.

The unit is operated by a central control panel containing air throttle engine controls and air-operating valves for controlling the pump clutches. An air pressure gauge in the panel indicates pressure in the air system.

For additional information, write Oil Well Supply Company, 2001 North Lamar, Dallas, *referring to* WORLD OIL *item* 248.

249—Flexible Couplings

This item supplements Morse Chain Company, Division of Borg-Warner Corporation, data as shown on pages 2782-2785 of Composite Catalog.

A silent chain flexible coupling, designated as Series DSC, consists of two sprockets wrapped with a center guide Morse Silent Chain. Disconnection is accomplished by unwrapping the chain after removing the single connecting pin or by moving either sprocket endwise out of mesh with the chain.

Stock bores range from ½-inch to 2⅞ inches, with horsepower capacities up to 119 horsepower at 2000 revolutions per minute. Either stamped steel or plastic covers are available.

For additional information, write for Catalog C 45-49, Morse Chain Company, 7601 Central Avenue, Detroit 8, *referring to* WORLD OIL *item* 249.

250—Crawler Tractor

This item supplements International Harvester Company data as shown on pages 2037-2040 of Composite Catalog.

The TD-24 diesel crawler tractor is equipped with an hydraulically controlled planetary gear train. Planet power final drive permits gradual turns with power on both tracks or pivot turns with one track locked, and provides a high-low speed range (both forward and in reverse) without shifting of transmission gears. This high-low speed range, in conjunction with the four-speed transmission and the reverse lever, gives the tractor eight forward and eight reverse speeds.

In operation, the planet power final drive system acts like two dual-speed

rear axles, each coupled independently to its respective track, and each hydraulically controlled by a separate lever. With one control lever in the high-speed range position and the other in the low-speed range position, the tractor makes a gradual turn with power on both tracks. With both control levers in the high-speed position, the tractor travels straight forward in high speed range. The same principle applies with both levers in the low-speed position. A third position of either lever locks the corresponding planet drive and track and puts the tractor into a pivot turn.

For additional information, write Industrial Power division, International Harvester Company, 180 North Michigan Avenue, Chicago 1, *referring to* WORLD OIL *item* 250.

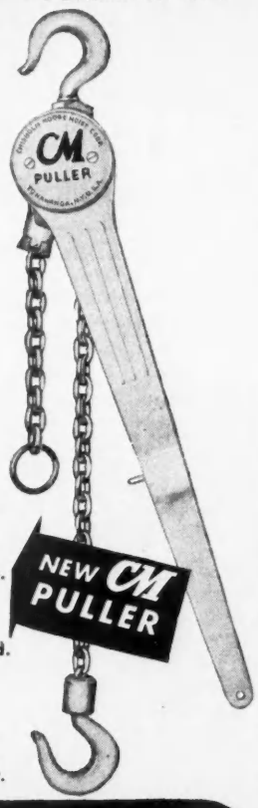
WHY BUY LESS

...the best costs so little

CM HOISTS AND PULLERS are ruggedly constructed to give you years of trouble-free service. Yet they are unusually light... easy to handle because they are constructed of the strongest alloys of steel and aluminum. Equipped with famous Herc-Alloy flexible, welded alloy steel chain.

- Capacities from ¼ to 10 ton.
- 1-ton model weighs only 35 pounds.
- 96% efficient—easy to operate.
- Lifetime lubricated.

NEW CM CYCLONE



- Capacities ¾, 1½, 3 and 6 ton.
- ¾-ton model weighs only 13 lbs.
- Lifts or pulls at any angle.
- Lifetime lubricated.

NEW CM PULLER

Write for catalog and name of your nearest CM dealer.

CHISHOLM-MOORE HOIST CORPORATION

(Affiliated with Columbus McKinnon Chain Corp.)

GENERAL OFFICES AND FACTORIES: TONAWANDA, N. Y.

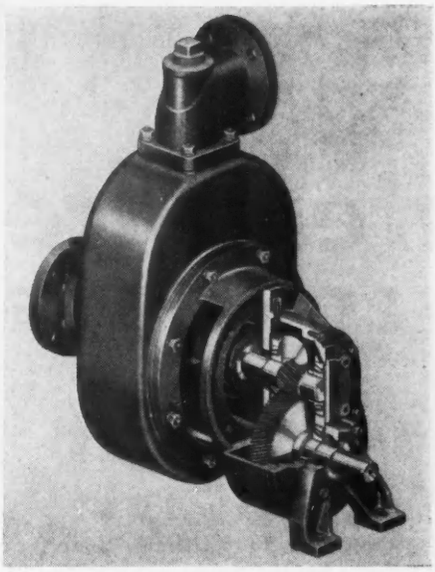
SALES OFFICES: New York • Chicago • Cleveland San Francisco • Los Angeles

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

251—Power Take-Off Pumps

This item supplements Marlow Pumps data as shown on page 2504 of Composite Catalog.



A power take-off tank truck pump with self-priming centrifugal operation is designed especially for petroleum tank truck operations. It is available in two- and three-inch sizes, high and low pressure, with capacities from 20 to 200 gallons per minute, flanged or threaded connections.

The built in gear increaser consists of precision gearing, direct coupled to the power take-off. The gear unit is fitted with a mounting bracket that permits installation in any one of four 90-degree positions. The discharge tee of the pump is similarly positionable.

Free-flow design and "diffuser" priming methods enable the pump to prime automatically and pump one compartment after another. It contains no auxiliary priming devices. The pump has a self-compensating shaft seal.

For additional information, write Marlow Pumps, 568 Greenwood Avenue, Ridgewood, N. J., *referring to* WORLD OIL *item* 251.

252—Plunger Pump

This item supplements Gaso Pump & Burner Manufacturing Company data as shown on pages 1385-1404 of Composite Catalog.

The Figure 3364 Horizontal Triplex Plunger Pump, has a capacity of 44 barrels per hour at 900 pounds working pressure.

The 2¼ x 3-inch pump was designed primarily for small oil leases, with special application to crude oil gathering systems, salt water disposal and fresh water supply.

It is equipped with a molybdenum alloy cast iron fluid end for oil service or with an aluminum bronze fluid end for corrosive fluids.

For additional information, write Gaso Pump & Burner Manufacturing Company, 900 East First Street, Tulsa, *referring to* WORLD OIL *item* 252.

253—Evener Assembly

This item supplements United States Rubber Company data as shown on pages 4150-4157, and Cabot Shops, Inc., data as shown on pages 897-899 of Composite Catalog.

A new rubber evener bearing used in the evener assembly of oil well pumping units, reduces from 100 to 38 the number of parts required for pumping unit construction.

In a special test, a unit with a rubber evener bearing assembly was given a severe unbalanced load and operated at three times normal field operating speed. The rubber evener bearing completed more than 40 million cycles, outwore many of the structural metal parts in the unit, and maintained serviceable operating condition, according to the manufacturer.

Rubber eliminates lubrication since the assembly needs no fractionally sliding or roller parts. It is resistant to salt water, sand, grease and grit, and insulates the gear box from excessive well

shocks caused by fluid pounds, gas locks, sanding up or paraffin. Assembly to provide for misalignment is unnecessary because of rubber's self-aligning properties.

Pictured is an oil well pumping unit equipped with the new evener assembly.

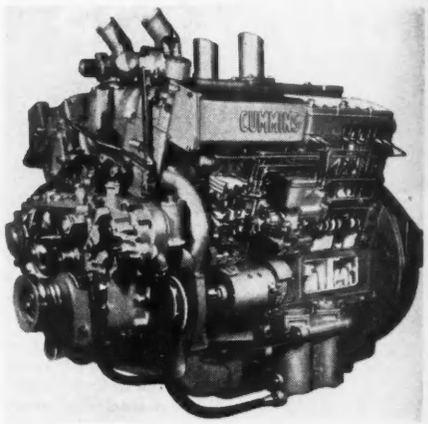
For additional information, write United States Rubber Company, Rockefeller Center, New York 20, or Cabot Shops, Inc., P. O. Box 1101, Pampa, Texas, *referring to* WORLD OIL *item* 253.

254—Diesel Engine

This item supplements Cummins Engine Company, Inc., data as shown on pages 1089-1108 of Composite Catalog.

The new four-cycle, 12-cylinder, V-type, supercharged Model NVHS-1200 Cummins Diesel has a maximum rating of 550 horsepower turning at 2100 revolutions per minute. It is designed for use in off-highway automotive units, other mobile mining and construction equipment, oil well drilling rigs, generator sets and other portable and stationary applications.

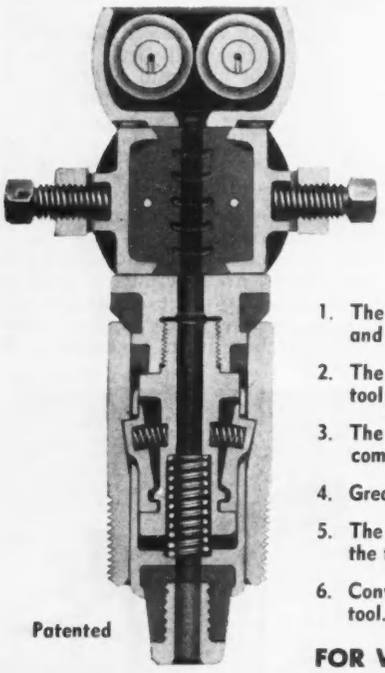
This engine is equipped with a new Cummins "DD" fuel pump, shown in the cutaway model. The pump contains a double disc arrangement. One disc



allows fuel to pass into the metering pump, while the other performs the distributive function only. A single plunger measures the fuel charge for all cylinders, so that each injector receives the proper predetermined amount of fuel at any required engine speed and load within the approved ratings. The fuel is delivered to the injectors at low pressure through a rotating distributor disc arrangement.

For additional information, write Cummins Engine Company, Inc., Diesel Drive, Columbus, Ind., *referring to* WORLD OIL *item* 254.

Low Maintenance
LOW COST — LONG LIFE



Patented

Be Sure IT'S A KING *Be Safe*

With A 3AR Wire Line
STRIPPER FOR SWABBING TUBING

Type 3AR King Wire Line Stripper ("Oil Saver") is the ideal tool to use in connection with swabbing operations.

1. The positive latch and sure release insure against accidents and eliminate the possibility of jerking a wire line in two.
2. The packing is inserted from the sides of the tool and the tool can be repacked while the line is in the hole.
3. The roller line guides center the line; outlasts the more commonly used bushing many times.
4. Grease nipples are provided to lubricate the guide rollers.
5. The non-sparking materials used in its construction minimize the fire hazard.
6. Convenient hand holds contribute to easy handling of the tool.

FOR WIRE LINE CORING THE 4AR KING WIRE LINE STRIPPER IS WIDELY USED

The Type 4AR Stripper is similar to the Type 3AR, except it is a little larger. It is commonly used in connection with the Type 4C King Circulating Head. It can be, and sometimes is, used with other makes of circulating heads.

These tools are constantly coming into greater use. A trial is convincing.

All prices F.O.B. Houston, Texas, and subject to change without notice.

Sold through your supply store

***Export:* R. S. STOKVIS & SONS, Inc.**
17 Battery Place, New York 4, N. Y.

See your Composite Catalog for detailed description of other King Tools.

KING OIL TOOLS
210 TERMINAL STREET **PHONE WO-8013**
HOUSTON 20, TEXAS

255—Gas-Liquid Separator

This item supplements Parkersburg Rig & Reel Company data as shown on pages 3349-3420 of Composite Catalog.

The Hydracepter is a device for the prevention of gas line freezing by the removal of free water—the cause of hydrate formation—from the gas line at the point in the system where the maximum portion of produced water is in the liquid phase.

It is a small, high-pressure, horizontal gas-liquid separator with a settling chamber for separation of water from the condensate in the line, so that the water-free condensate may be returned to the line and carried on with the gas. It is installed directly in the gas line.

The settling chamber, supported at one end below the separating chamber by the pipes connecting the two vessels, performs the functions of a float, thereby eliminating the need for an internal float. The unsupported end of the settling chamber rests some of its weight on a strain gauge pilot.

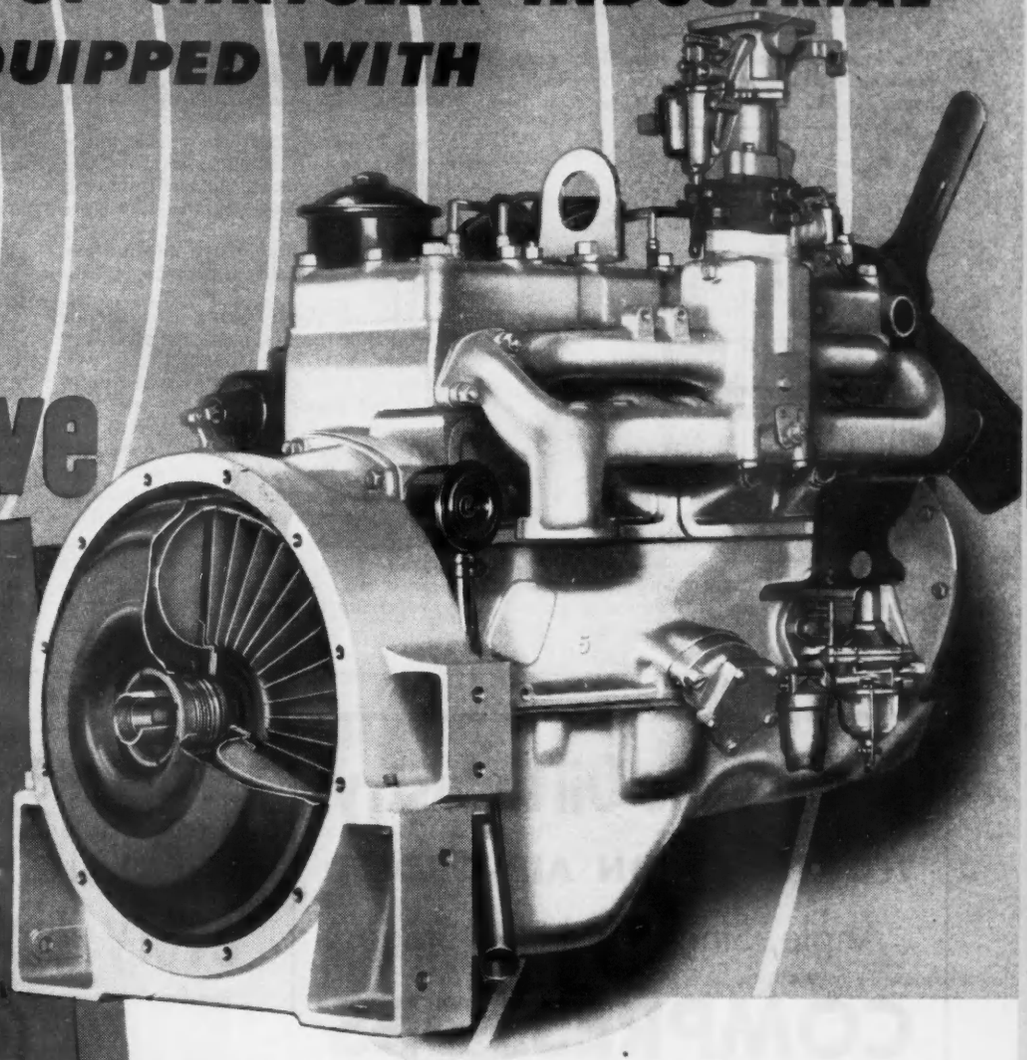
The Hydracepter is available in two types. Type "W," for removal of water only, permits all hydrocarbons, both liquid and gas, to flow on to the plant or separator. Type "L" removes all liquids and is installed on supply lines to drilling rigs, camp fuel systems and gas transmission lines generally.

For additional information, write Parkersburg Rig & Reel Company, 1941 Crawford Street, Parkersburg, W. Va., *referring to* WORLD OIL *item* 255.

New Operating Advantages

FOR USERS OF CHRYSLER INDUSTRIAL ENGINES EQUIPPED WITH

gyrol Fluid Drive



ABSORBS SHOCK OVERLOADS in a safety cushion of oil!

PREVENTS ENGINE STALLING.

REDUCES CLUTCH WEAR.

ELIMINATES JOLTS, AND GEAR RATTLE!

PERMITS ENGINE TO BE SPEEDED UP TO TORQUE PEAK with output shaft turning at lower speed!

SIMPLIFIES STARTING from standstill with excessive load!

GIVES GRADUAL OIL—SMOOTH ACCELERATION from a standing start to full speed and in certain installations from full speed forward to full speed reverse.

ALLOWS STOPPAGE for brief periods without de-clutching!

ELIMINATES DOWN TIME caused by shock overload when machine hits an obstruction. In such cases, Fluid Coupling absorbs 100% of the shock. No shear pins to replace!

PROVIDES GREATER EASE OF HANDLING when jockeying into position!

COSTS ONLY A FEW DOLLARS MORE THAN THE CONVENTIONAL FLYWHEEL WHICH IT REPLACES

Here is *super-smooth* power flow for your power transmission train—a safety cushion of oil between power and load—a Fluid Coupling that operates with no metal-to-metal contact between Driver and Runner.

With gyrol Fluid Coupling, Chrysler Industrial engines now offer exclusive new operating advantages to builders and operators of many types of gasoline-powered machines.

Chrysler's famous gyrol Fluid Coupling has been proved on *more than a million* Chrysler, De Soto and Dodge passenger cars and trucks over a period of 11 years. Proved on scores of industrial applications, too.

See your nearest Chrysler Industrial Engine Dealer or write ***Industrial Engine Division, Chrysler Corporation, Detroit 31, Michigan.***

CHRYSLER

Industrial Engines and Power Units

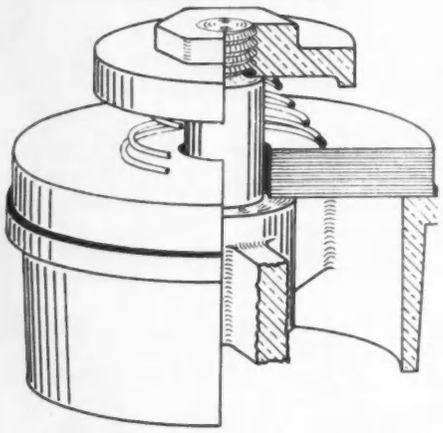
HORSEPOWER WITH A PEDIGREE

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

256—Industrial Pump Valves

This item supplements American Iron and Machine Works Company data as shown on pages 221-260 of Composite Catalog.



Designed for reciprocating pumps in such uses as pipe line and refinery service, industrial pump valves, valves and seats are furnished in bronze alloy with a special phenolic valve plate for operating temperatures up to 300° F. and pressures up to 750 pounds per square inch. For temperatures up to 950° F., this same design is available in stainless steel.

In the three-web seat, the center guide post is cast as an integral part of the hard bronze alloy seat, thus eliminating a threaded connection which often corrodes and breaks.

The phenolic valve plate can be reversed when one side becomes excessively worn.

The conical valve spring is made of bronze or steel spring wire which offers only four pounds resistance. It will compress to a height of one-eighth-inch, with no coil clash.

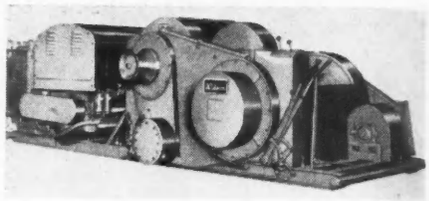
The valve and spring retainer is recessed to prevent damage to the conical spring when valve is fully opened. Valve plates can be changed without removing seat from the pump.

For additional information, write American Iron and Machine Works Company, P. O. Box 1777, Oklahoma City, *referring to* WORLD OIL *item* 256.

257—Double-Drum Rig

This item supplements Wilson Manufacturing Company, Inc., data as shown on pages 4341-4376 of Composite Catalog.

A double-drum rig, the Mogul Torcair, will drill up to 4000 feet with 4½-inch drill pipe. The rig is also rated for



well servicing up to 8000 feet with 2½-inch tubing without hydromatic brake. When the brake is added to the rig, the equipment is capable of doubling that servicing depth.

It has torque converter drive and full air controls. Air-tube disc clutch is used and all air connections are on the outside.

AIR for the Oil Industry

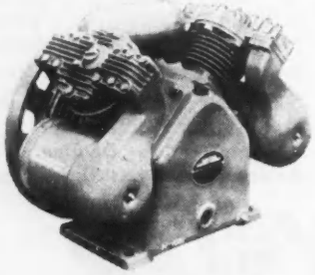
WORTHINGTON AIR-COOLED

Angle, Single and Two-Stage

COMPRESSORS

1 HP to 15 HP

Available as Bare Units with V-Drive Sheaves; or Tank-Mounted as well as Base-Mounted. Electric or gasoline engine drive.



★

FIELD STOCKS AT CONVENIENT POINTS

★

A. M. LOCKETT & COMPANY, LTD.

HOUSTON NEW ORLEANS DALLAS

"I'll take the WHITE one every time!"

WYTEFACE "A"
Trade Mark

Steel Tapes for the Oil Industry

WYTEFACE "A" Steel Tapes have raised black graduations on a crack-proof white surface. Easy to read in any light, from any angle. Designed for hard service. Resist rust and corrosion. Raised rims and markings protect the white background from abrasion from rails, pipe, rocks, concrete. Made in styles especially for Oil Riggers, Oil Gaugers and for general measurements. See your supply house, or write for details to Keuffel & Esser Co., Hoboken, New Jersey.

K+E

Drafting, Reproduction, Surveying Equipment and Materials, Slide Rules, Measuring Tapes.

KEUFFEL & ESSER CO.

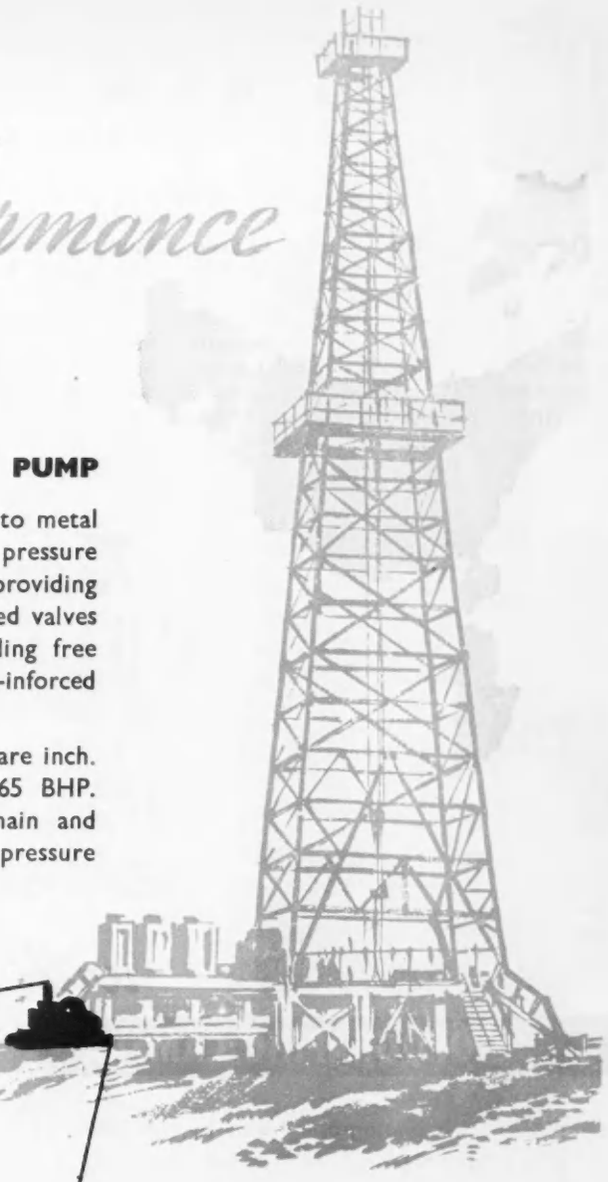
EST. 1867

NEW YORK • HOBOKEN, N. J.

Chicago • Detroit • Los Angeles
St. Louis • San Francisco • Montreal

First class performance

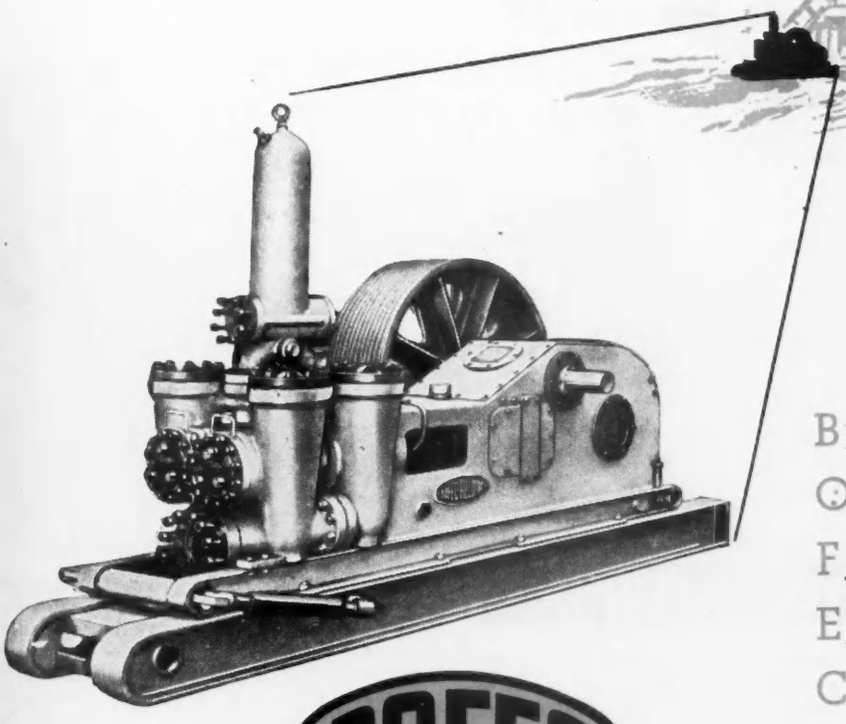
IN ALL CONDITIONS



BOFEC-FIELDING TYPE SPA 12 SLUSH PUMP

4 pot superimposed valve pattern. Valve cage metal to metal taper seat with pressure seal. Valve covers fitted with pressure seals ensuring positive hold down of valve cage and providing automatic pressure closure of valve cover. Stream lined valves self cushioning type and seats without bridges providing free flow of fluid. Fabricated power end, braced and re-inforced for maximum strength.

All steel construction. Tested to 3500 lb. per square inch. 12″ stroke. Max. liner dia. 7¼″. Power input 165 BHP. Dbl. helical reduction gears. Roller bearings on main and pinion shafts and on eccentrics. Maximum working pressure 2000 per square inch.



BRITISH MANUFACTURE
OIL RESISTING RUBBERS
FABRICATED CONSTRUCTION
EARLY DELIVERIES
COMPETITIVE PRICES

BOFEC

REGD. TRADE MARK

BRITISH OILFIELD EQUIPMENT COMPANY LIMITED
Duke's Court, 32, Duke Street, London, S.W.1.
Telephone: Whitehall 6177 **Cables: Bofec Piccy London**

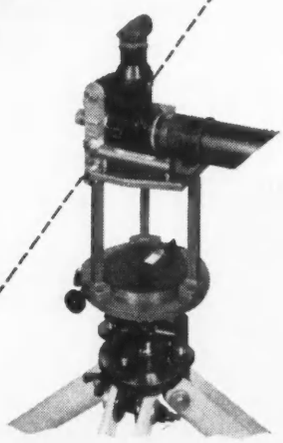
The catheads, which are held in place by one bolt, are removable to bring the unit to eight feet in width.

The unit can be equipped with a 15-inch double rotor type hydromatic brake driven by a chain drive from the countershaft. This brake can be used with either upper or lower drum. When used on main drum with five lines strung up it will absorb a total of 1300 horsepower when dropping the stands at the rate of 60 feet in 12 seconds. The brake is so arranged that it will absorb little power when taking up the empty blocks, and jaw clutch does not need to be disengaged to take up the empty blocks when the trip is completed.

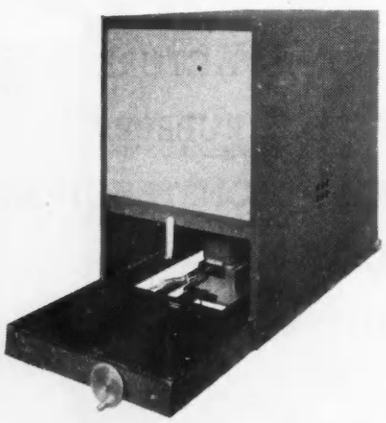
An air valve at control position operates a water valve in the cooling system to control the amount of braking action. The engine cooling system and the hydrotarder cooling system have been combined so that engine radiators serve to cool the brake water when going in the hole.

For additional information, write Wilson Manufacturing Company, Inc., P. O. Box 329, Wichita Falls, Texas, *referring to* WORLD OIL *item* 257.

Take the
GUESSWORK
OUT of
GEOPHYSICAL SURVEYS
with the NEW
TOPOGRAPHIC CAMERA



Each photograph taken by this new field instrument records all the data needed for the accurate determination of distance, direction and elevation difference between instrument and rod — eliminates all reading in the field.



CONVERSION PROJECTOR

This new film reading device measures vertical angle differences to within 6 seconds of arc, distances to within 5 feet in 1000 feet, horizontal angles to 15 minutes — permits visual office interpretation of all field survey operations.

Both the Topographic Camera and the Conversion Projector are easy, fast and economical to operate — and are now available for sale or lease. Write for further details.

Rx

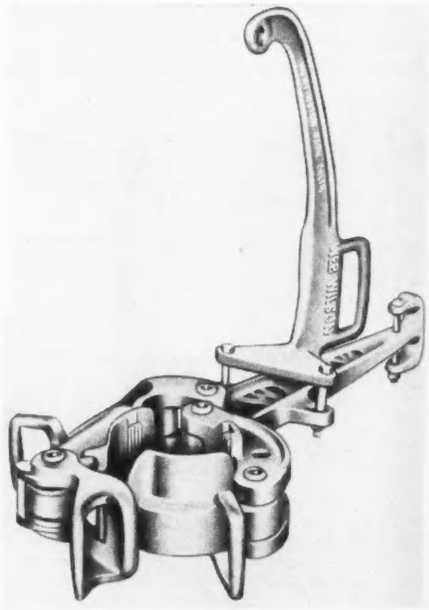
REPUBLIC EXPLORATION COMPANY
TULSA, OKLAHOMA

258—Lightweight Tong

This item supplements Web Wilson Oil Tools, Inc., data as shown on pages 4317-4340 of Composite Catalog.

The new Type D tong, adaptable to the needs of operators of portable mast rigs for shot-hole and geophysical operations, is designed on the three-jaw principle.

It has a spiral hinge pin arrangement for equalized pressure against the drill



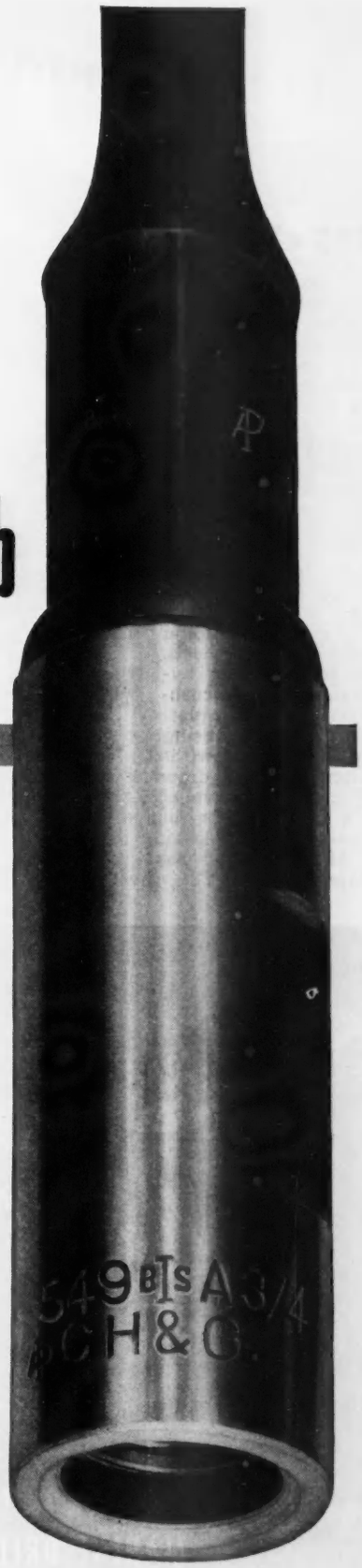
pipe from all three jaws. It equalizes the loading stresses on the hingepins and jaws so as to minimize breakage of these parts.

Size range of the tong is changed by replacing the lug jaw. Size ranges of the individual lug jaws are 2⅜ to 3⅛ inches; 2⅞ to 4⅛; 4 to 5¼ and 5¼ to 6¼.

Distance from the center of the pipe to the end of the lever when the tong is in operating position is 29½ inches. It uses standard 4¼-inch long tong dies and a one inch diameter hinge pin. Weight is approximately 95 pounds.

For additional information, write Web Wilson Oil Tools, Inc., W. W. Wilson Building, Huntington Park, Calif., *referring to* WORLD OIL *item* 258.

this sturdy coupling keeps sucker rods on the job



for a long-lasting coupling—one that keeps sucker rods on the job—choose the Bethlehem coupling.

The Bethlehem coupling is made from either carbon or alloy steel, and is ideal for use in sucker rod strings because it comes carburized, hardened and ground for protection against well wear. It is also furnished unhardened. The coupling is tapped after heat-treatment to avoid distortion of threads, and it provides a tight fit with the rod because care is taken during manufacture to grind the two coupling faces at right angles to the threads.

You're missing something if you haven't used the Bethlehem coupling. Why not give it a workout on your next pumping job?

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

BETHLEHEM *Sucker Rods*

BETHLEHEM STEEL

OTHER NEW AND IMPROVED *Equipment*

259—Tilting Trailer

Two tilting trailers for hauling tractors, mixers, compressors and similar bulky equipment can be loaded or unloaded by one man without skids or blocks. The trailers can be used behind any standard one-half to one ton truck equipped with standard pintle-hook.

Model TSA-2 has eight to ten ton capacity with 96- by 187-inch platform, and rides on a single axle with two wheels. A double-acting hydraulic cylinder cushions the trailer platform when it is being tilted with or without load. The one-piece axle and drawbar are removable. The trailer is available with heavy-duty La Crosse air or vacuum brakes, safety chains and six lashing rings.

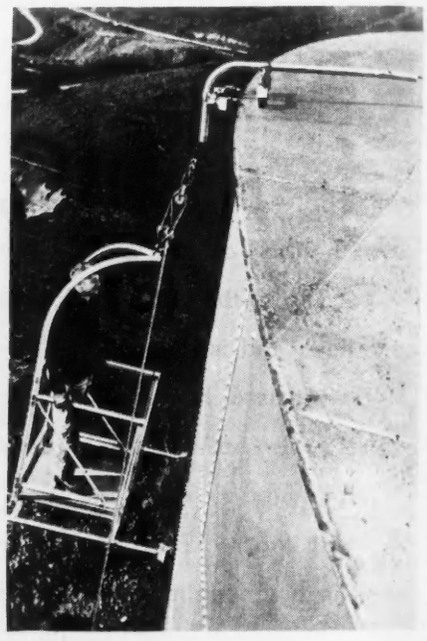
Model LTA-4 has six to eight ton capacity with a 78¼- by 124½-inch platform, and rides on a tandem axle with four wheels. The entire trailer tilts for loading by removing a pin from the hinged drawbar. The weight of the load brings the trailer down into position, after which the pin is inserted and the trailer is ready to move. It comes equipped with Warner electric brakes, safety chains and four lashing rings.

For additional information, write La Crosse Trailer Corporation, Gould and Sumner streets, La Crosse, Wis., *referring to* WORLD OIL *item* 259.

260—Safety Cage

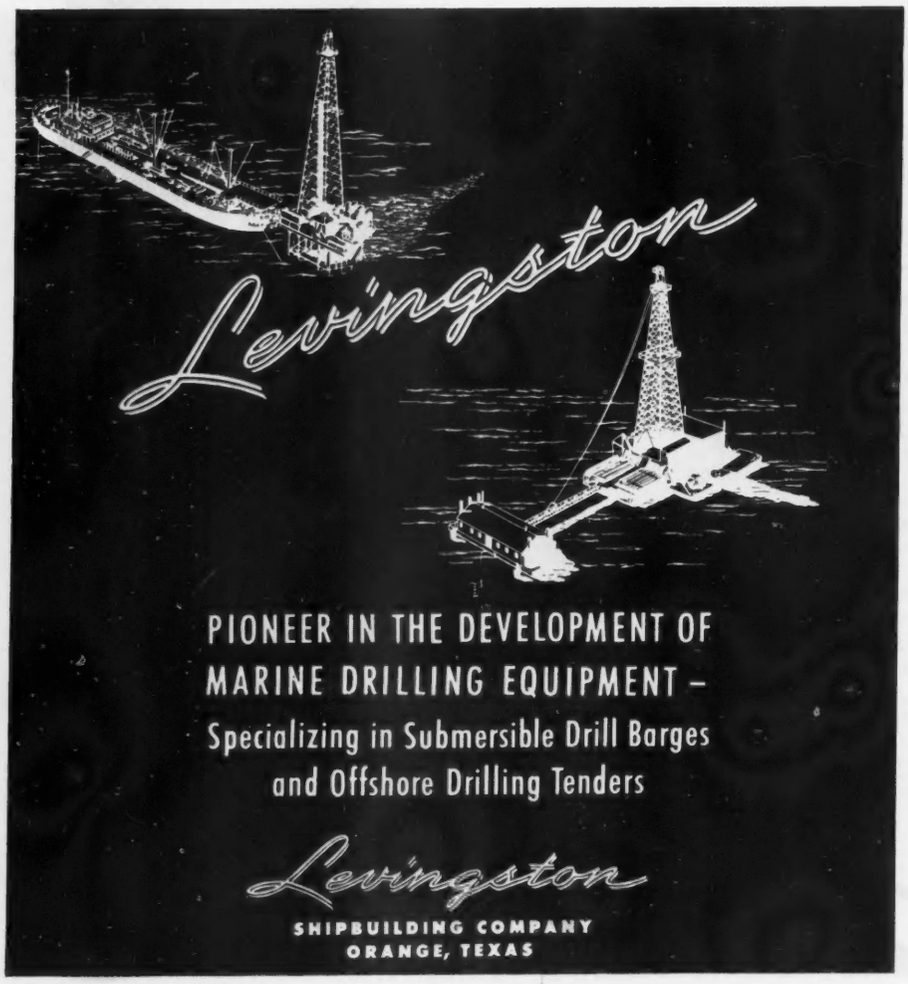
A high degree of safety in tank maintenance is provided with a new aluminum alloy Roll-Around safety cage.

Mechanism of the cage weighs 25 pounds, and can be carried by one man to the top of the tank. A wire cable is fastened to an eye-bolt in the center of the top of the tank, threaded through the curved tube of the Roll-Around, and fastened to a block-and-tackle or electric hoist. The set of casters which roll on top of the tank next to the rim can be locked whenever desired to prevent rolling. Bracket on which the other set of casters is mounted is adjustable vertically to permit the casters to roll on the rim of the tank, no matter how the tank is constructed.



The safety cage, weighing 70 pounds, can be raised with the operator to the height desired. The operator's safety belt is fastened to the rear guard rail. Arched support construction permits free movement of pole guns and other tools from side to side. Caster wheels are widely spaced to prevent the cage from being whirled around by wind. Adjustable legs enable the operator to position the cage the proper distance from the tank surface.

For additional information, write Up-Right Scaffolds, 1013 Pardee Street, Berkeley, Calif., *referring to* WORLD OIL *item* 260.



MARSH GAUGES

Under the grind
of daily service
Marsh Gauges
stand out
as the kind that
maintain
their accuracy.

JUST OFF THE PRESS

New, fact-filled catalog covering Marsh instruments. Ask for your copy.

JAS. P. MARSH CORPORATION
DEPT. K, SKOKIE, ILLINOIS

The Jas. P. Marsh line includes gauges especially designed for blenders, boilers, burners, capping, Christmas trees, columns, heaters, hydrogen units, instrument panels, pumps, Reid vapor bombs, scrubbers, separators, mud pumps, stills, towers, and other applications including oxygen and welding gauges.

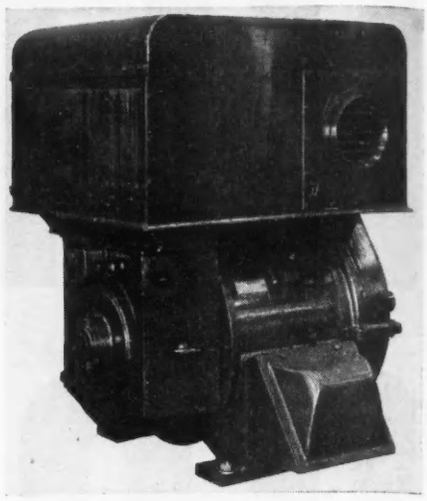
261—Unit Cooled Motors

Standard totally-enclosed, unit-cooled direct current motors in ratings up to 200 horsepower are available with a new type cooling assembly which enables them to operate at slow speeds for long periods of time.

Two blowers, driven by a single G-E Tri-Clad induction motor, in the air-to-air cooling assembly provide ventilation independent of motor speed. One blower circulates internal air through the motor and unit cooler, while the other blows external air through the cooler. The new cooling system makes full torque possible down to almost zero speed continuously.

The unit cooler is built of pressed-steel sheets which have been stacked and welded together at the edges to provide alternate air passages at right angles to each other. Upon entering the cooler, clean air from the motor is broken up into small streams by multiple passages which are surrounded by similar streams of cool air coming from the outside.

Motor air never comes into contact with the contaminated outside air. The outside air, flowing through the alternate set of passages at right angles to the external passages, absorbs the heat from the internal air stream.



Designed for operation in dusty, dirty, and oil-laden atmospheres, the motors require no piping, duct-work, air filter, or pressurized air supply.

For additional information, write General Electric Company, Schenectady 5, N. Y., *referring to* WORLD OIL *item* 261.

Bottom Water is a drain on profits

Eagle Lead Wool

shuts out Bottom Water!

To insure an uninterrupted flow of oil from your wells, banish bottom water with economical Eagle Lead Wool. This finely stranded metallic wool, tamped around the hole, effectively seals every crack, becomes a permanent, non-corrosive plug. Packed in convenient 50-pound sacks—easy to place in special cartridge-shaped Eagle Wire Containers sized to fit all casings.

These 3 Eagle Bearing Metals meet most requirements

Eagle Dreadnaught — for extreme speed and heavy-duty conditions.

Eagle Outlasta — for medium speed and average-load conditions.

Eagle Durable—for low speed and light-duty conditions.

EAGLE LEAD WOOL

Seals off Bottom Water— keeps 'em flowing!

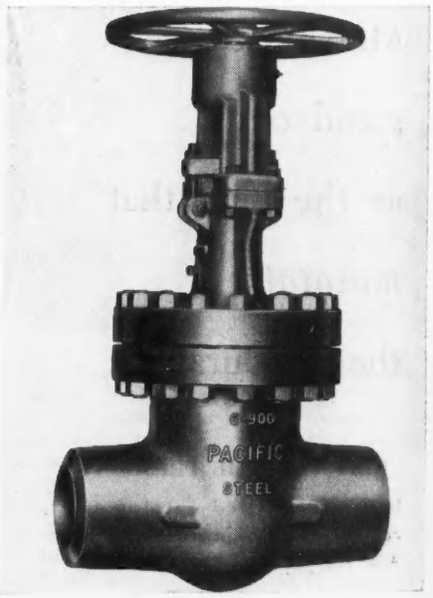
THE EAGLE-PICHER COMPANY

EAGLE Since EP 1843 PICHER

Cincinnati . East St. Louis Chicago . Dallas . Kansas City

262—Gate Valve

Cast steel gate valves in a 900-pound series are designed to meet all recognized specifications. They have uniform wall thicknesses and flange sections, and are constructed of cast steel conforming to ASTM specification A 157 Type Cl,



or can be made to individual requirements.

The valves are available with welding or flanged end in sizes 3-, 4-, 6-, and 8-inch.

For additional information, write Pacific Valves, Inc., 3201 Walnut Avenue, Long Beach 7, Calif., *referring to* WORLD OIL *item* 262.

Run Tubing FASTER!

with

RATIGAN

NO. 214 TUBING TONG

High tension spring holds jaw in place for placing on tubing instantly.

Dies are changed quickly and easily, simply by turning a lock nut.

Lighter In Weight

Easier To Handle

Maximum Safety

Ratigan #214 "quick-acting" Tubing Tong takes a positive, sure grip instantly. It is correctly balanced, and the rachet-like action speeds up the job of running tubing. It is new in design and much lighter in weight, than previous Ratigan Tongs. . . . permits easy handling for maximum safety.

The #214 has greater strength and is always in position to be put on the tubing. The dies are held at the proper angle and can be changed in less than one minute. They simply slip into place and are held firmly in position by a lock nut.

Three size jaws are available—2", 2½" and 3"—and are quickly and easily changed.

For complete information on all Ratigan products consult your latest addition of the Composite Catalog.

J. P. RATIGAN, INC.

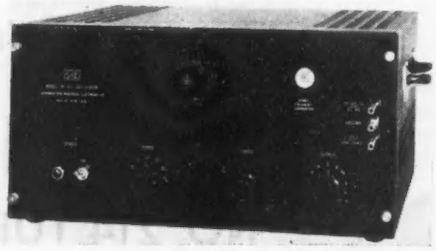
1213 SANTA FE AVENUE, LOS ANGELES 21, CALIFORNIA

Export: **National Supply Export Corporation, 30 Rockefeller Plaza, New York, N. Y.**

RATIGAN PRODUCTS ARE SOLD THROUGH LEADING SUPPLY STORES

263—Oscillator

Circuit of the Model "M" Oscillator has no lower limit to its possible frequency of oscillation. The frequency is continuously variable from 1 to 120,000 cycles per second in five overlapping ranges. Two positions are provided on the range selector switch for fixed frequencies which are determined by units which plug into the central tuning assembly. Plug-in units may be obtained for frequencies as low as 0.1 cycles per second.

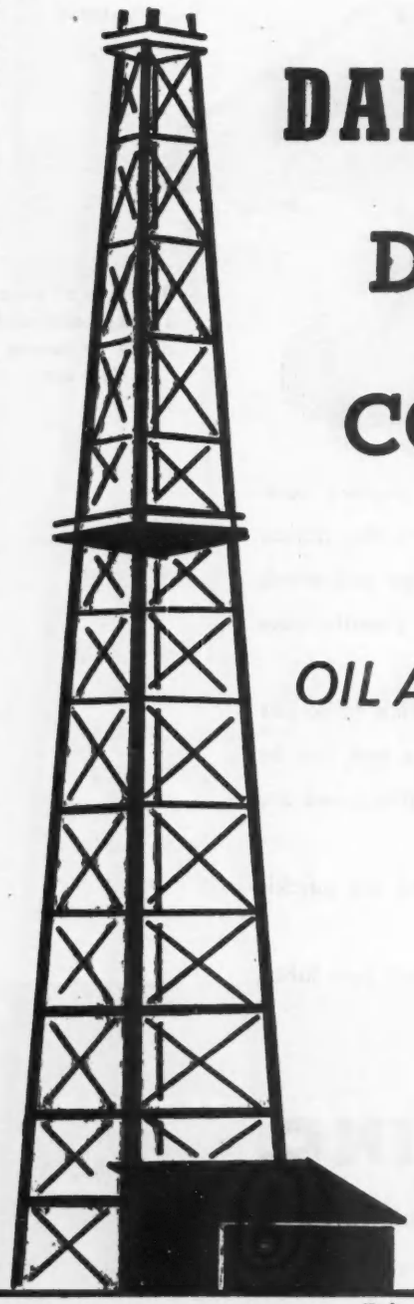


The circuit uses two separate amplifiers connected by a four-terminal bridge network. The circuit is self-balancing and direct current is kept out of the thermal amplitude control element without use of a blocking condenser. The entire circuit is fed from an electronically regulated power supply. Oil filled filter, bypass and coupling condensers are used. One electrolytic condenser is used for output coupling.

Power consumption is 140 watts at 115 volts and 60 cycles per second. The instrument is 9¾ inches high, 18½ inches long, and 12 inches deep.

For additional information, write Southwestern Industrial Electronic Company, 2831 Post Oak Road, Houston 19, *referring to* WORLD OIL *item* 263.

DAN L. CLARK W. M. AVERILL RUPERT COX



DAN L. CLARK

DRILLING

COMPANY

Drillers of

OIL AND GAS WELLS

POWER AND STEAM RIGS

WILSON BUILDING

CORPUS CHRISTI, TEXAS

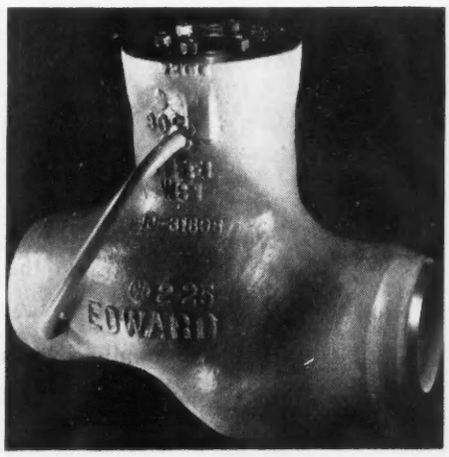
Telephones

Local 7746—7747 Long Distance 95

264—Check Valve

This cast steel valve body makes possible smaller check valve installations. Because the new body design reduces pressure loss 40 percent, a size smaller check valve can do the work of a larger valve.

Smaller body size has been achieved by the use of integral Stellite seat and Edward Equalizer which allows the disk-piston to rise completely out of the path of flow, thus utilizing the entire



flow passage. Bonnet bore is only slightly larger than the ASA standard for port openings. As a result of this, overall weight of the valve is reduced and pressure load on the bonnet seal and operating mechanism is minimized. Tubular design of the disk-piston is of minimum weight and prevents over-the-disk flow.

Equalization of pressure in all internal areas of the valve, reduction of weight in the floating disk-piston, and streamlined internal contours which eliminate turbulence combine to decrease pressure loss in the new body design.

Check valves with new body design are built in 900-, 1500-, and 2500-pound classes with both globe and angle patterns. They are available with pressure-seal or bolted bonnet and with flanged or welding ends.

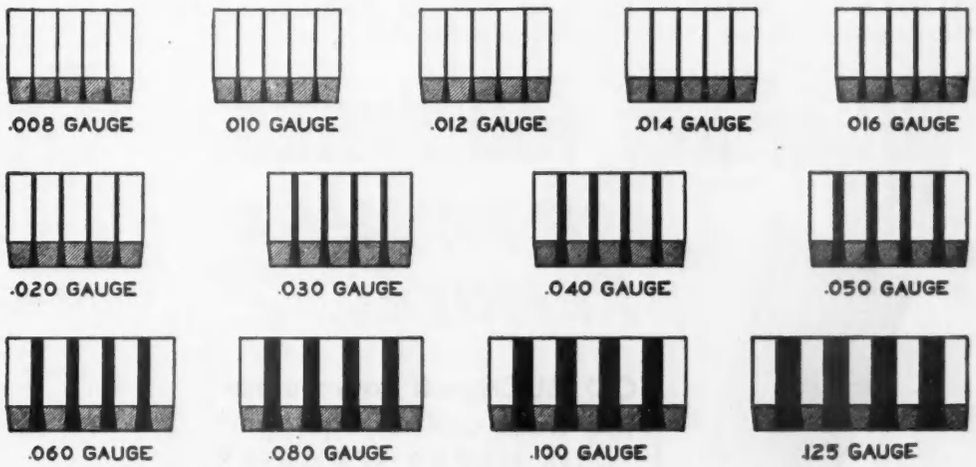
For additional information, write Edward Valves, Inc., 1234 West 145th Street, East Chicago, Ind., *referring to* WORLD OIL *item* 264.

THE LAYNE

wire wrapped SCREEN

Available in "Your Choice" of Gauge Opening

Milled Groove



The black lines represent the spaces between the wires. Shaded portions show shape and size of wires.

In the Layne Wire Wrapped Screen, you can get the gauge opening best suited to your sand problem. The Screen is wrapped to any gauge desired. The table above gives an idea of the actual size of opening in various gauges.

Layne Wire Wrapped Screen offers a choice of Galvanized Steel Wire; Admiralty Brass Wire; Commercial Bronze Wire, and 18-8 Stainless Steel Wire, all the same dimensions, drawn and annealed to our specifications, with strength and toughness to withstand abrasion, yet ductile enough to permit wrapping on the pipe.

The Wire is a flat bottom semi-V shape, so when wrapped on the pipe, produces an inverted opening of the same shape that flares towards the openings in the pipe. This semi-V shape opening resists clogging as it offers a freer passageway for the fluid after it leaves the screening point of the wires. Anything passing the screening point will be pumped out.

"WHEN YOU USE A LAYNE SCREEN—YOU ARE USING THE BEST"

●

THE LAYNE AND BOWLER COMPANY

EXPORT:
Jeff Tucker
Room 1636
30 Rockefeller Plaza
New York, N. Y.

General Office & Factory
8000 Market Street Houston, Texas

WEST COAST:
Layne & Bowler Corp.,
900 Santa Fe Ave.,
Los Angeles, Cal.

265—Oil Field Engines

The publication, "Shallow or Deep Drilling with 'Caterpillar' Oilfield Engines," is an eight-page, two-color booklet containing pictures and information on oilfield installations.

Two pages of the booklet are devoted to statistics and specifications of diesel engines. The model, horsepower, bore and stroke, etc., are given for the inspection of oilfield men.

For a copy of this booklet write Caterpillar Tractor Company, Peoria 8, Illinois, requesting Form 12315, *referring* WORLD OIL *item* 265.

266—Slush Pump Liners

Liners for every principal make of slush pump are listed in a 12-page illustrated catalog. Explained in the brochure are improved techniques in the manufacture of liners used under great pressures and highly abrasive muds.

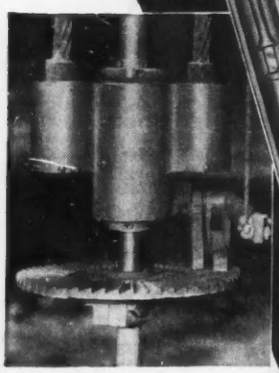
For a copy of catalog No. 104, write Falcon Products, Inc., 949 East Second Street, Pomona, Calif., *referring to* WORLD OIL *item* 266.

WHAT ARE YOU PAYING FOR PARAFFIN REMOVAL?

TOO MUCH — If your pumping wells are not equipped with HUBER SCRAPERS

Many major companies report Huber Scrapers have completely eliminated paraffin removal costs or reduced them to only a fraction of a cent per barrel of oil produced. Huber Scrapers, shrink-fitted to new or used sucker rods, scrape the paraffin from the tubing wall as the string rotates and reciprocates. Rods are rotated by the special Huber Rotating Rod Hanger.

Reduce or eliminate your paraffin removal costs with Huber Scrapers. Write for latest bulletin.



HUBER ROTATING ROD HANGER

This rod hanger rotates the rod string a fraction of a turn on each reciprocation. Two ratchet levers, operated by a flexible cable extending from the walking beam, engage the teeth in the turntable to turn the rod string.

Sold through supply stores.

J. M. HUBER CORP.
P. O. Box 831
BORGER, TEXAS

HUBER
PARAFFIN SCRAPERS
SCRAPE AS THEY ROTATE AS THEY RECIPROCATE

267—Drilling Equipment

Four catalogs describe Cardwell equipment. An eight-page brochure concerns the Trailerig, a portable, self-contained unit. Model O drawworks, either air-controlled or manually-controlled, is the subject of another eight-page bulletin. Model R, Model K and Model H double drum combination units are depicted in a 12-page catalog. All of these models can be used for both cable tool and rotary work, and well servicing.

The fourth catalog gives information on the Model L drawworks, an air-controlled unit which is available as a simple hoist in either a single or double drum version, as well as fully equipped with rotary drive, automatic cathead, etc., for use as a drawworks.

For copies of these catalogs, write Cardwell Manufacturing Company, Inc., P. O. Box 2001, Wichita 1, Kansas, *referring to* WORLD OIL *item* 267.

268—Diamond Bit Catalog

The manufacturing facilities and complete line of diamond drilling bits of the Wheel Trueing Tool Company are described in a 31-page multi-colored catalog. Full specifications and illustrations of each type diamond bit are presented. Of particular interest to users of diamond bits is a seven-page article on the care and use of diamond bits.

For a copy of this catalog, write the Wheel Trueing Tool Company, 3200-3220 West Davidson Ave., Detroit 6, *referring to* WORLD OIL *item* 268.

269—Load Measuring Beam

A two-page illustrated bulletin, No. 274, describes the applications of SR-4 load beams, such as for process and machine control, and for general force measurement. The beams are sensitive and accurate force measuring cantilevers on which SR-4 bonded resistance wire strain gauges serve as force measuring elements for a wide range of loads.

For a copy of this bulletin write The Baldwin Locomotive Works, Testing Equipment department, Philadelphia 42, *referring to* WORLD OIL *item* 269.

270—Pump Control

Pump control for domestic commercial and industrial water systems is described in a 37-page booklet, "Precision Control for Pumps."

Outlined are controls for domestic water systems, deep wells and small compressors, deep well pumps and large compressors, standard duty sumps and tanks, cellar drain and other light duty sumps.

For a copy of this booklet, write Cutler-Hammer, Inc., 414 North 12th Street, Milwaukee 1, *referring to* WORLD OIL *item* 270.

Schram and Miller to Address AGA Convention at Chicago

Emil Schram, president of the New York Stock Exchange, will be the keynote speaker at the 31st Annual Convention of the American Gas Association in Chicago, October 20. More than 6000 gas utility representatives are expected to attend the four-day conference from October 17-20 at the Palmer House, Morrison Hotel and Sherman Hotel.

Headlining the program on October 19 will be Harry M. Miller, chairman. The Ohio Public Utilities Commission, and recently elected president, National Association of Railroad and Utilities Commissioners. Miller will speak on "Duplication of Regulation," sustaining in so far as possible the jurisdiction of the states in matters of intra-state regulations.

More Than 1000 Oil Men To Attend IPAA Meeting

Forty-four states will be represented by more than 1000 oil men who will convene in Fort Worth October 3-4 for the Twentieth Anniversary Meeting of the Independent Petroleum Association of America. Fort Worth was also the site of the first annual meeting of IPAA in 1929.

Although the meeting officially opens October 3, which IPAA has designated "Founders Day" in honor of those who attended the Association's organizational meeting at Colorado Springs, Colo., two committees and the IPAA staff will meet Saturday, October 1, with other advance committee meetings scheduled for Sunday.

Speakers for the meeting include Louis Johnson, U. S. Secretary of Defense; Walter Hallanan, president of Plymouth Oil Co., Pittsburgh, and chairman of the National Petroleum Council; A. E. Sweeney, Jr., director of the secondary recovery division of the Interstate Oil Compact Commission; W. L. Horner, chief engineer, Barnsdall Oil Company; and W. C. Vollmer, president of the Texas and Pacific Railway Company.

Hallanan will speak on "The Value of Free and Independent Leadership," while Vollmer will speak on "Trends in Americanism."

Sweeney will report on "Findings of the National Stripper Well Survey Made Jointly by the Interstate Oil Compact, National Stripper Well Association, and the Independent Petroleum Association of America," while Horner will speak on "Increased Oil Recovery by Means of Water Injection Pressure Maintenance."

The Economics and Cost Study committee and Supply and Demand committee will meet Saturday. Reports of these groups are widely distributed throughout the industry, and are regarded as authoritative analyses of petroleum industry conditions.

Committeemen are Ralph Cummins, Registration committee chairman, Amon Carter, Sid Richardson and George Hill, Entertainment committee; Harold Neely, chairman, Registration and Reception committee; and W. A. Landreth, chairman, Transportation committee. W. A. Moncrief, Sr., is General Arrangements committee chairman, with W. J. Weaver as co-chairman.

State vice presidents, Executive committee members and officers of the Association will be nominated at the board of directors meeting at 3 p.m. Monday. Committee reports will be presented at the morning business session at 10:45 a.m. Tuesday.

API Names Committeemen; Awards Research Fellowship

T. V. Moore, Standard Development Company, New York, and H. G. Vesper, California Research Corporation, San Francisco, have been appointed chairmen of two API advisory committees on fundamental research. Moore succeeds Earl G. Gaylord as head of the advisory committee on fundamental research on the occurrence and recovery of petroleum, and Vesper succeeds W. J. Sweeney as chairman of the advisory committee on composition and properties of petroleum.

Dr. M. G. Mayberry of the Mellon Institute of Industrial Research, Pittsburgh, has been awarded a fellowship to develop a suitable thread compound for oil country tubular goods.

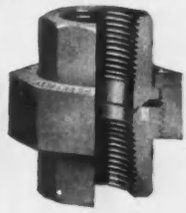
San Antonio Chapter AAODC Elects Coquat Chairman

Henderson Coquat, president and general manager of Longhorn Drilling Company, was elected chairman of the San Antonio chapter, AAODC. Other officers elected were Dan L. Clark, Dan L. Clark Drilling Company, Corpus Christi, vice chairman, and Marvin W. Rogers, Allen and Morris, secretary.

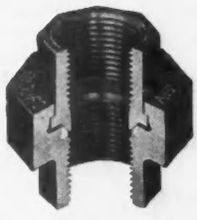
Outgoing officers include John E. Newman, Newman Brothers Drilling Company, chairman, Field M. Davis, Rock Hill Drilling Company, vice chairman, and T. Noah Smith, Jr., Logco Drilling Company, secretary.

Jefferson Malleable Unions

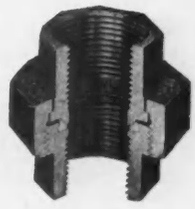
STYLE "B"—3-Part Ground Joint pipe line flange union greatly facilitates the laying of pipe and especially where pipe is out of alignment. Certified Air Furnace iron. Sizes ½" thru 10".



STYLE "A"—Ground Joint union and union fittings. Complete line straight and reducing. Sizes ⅛" thru 2½"—3000 lb. test; 3" and 4"—2000 lb. test. Made of Certified Air Furnace iron.



ENDURO—300 lb. S.W.P.—600 lb. C.W.P. unions. Sizes ⅛" thru 3".



EXCEL—250 lb. S.W.P.—500 lb. C.W.P. unions. Also a complete line of unions, ells and union tees with union on the run. Made of Certified Air Furnace iron. Sizes ¼" thru 3".

Obtainable through your jobber

Jefferson Union Company, Inc.

691 West 26th St.,
New York 1, New York

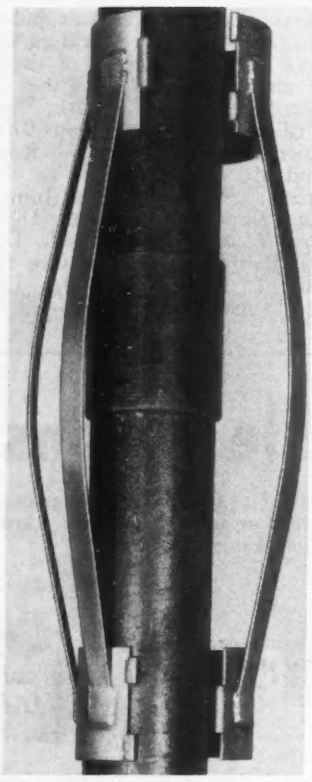
71 Gooding St., Lockport, New York **31 Fletcher Ave., Lexington 73, Mass.**

AIME Petroleum Branch Will Study Technology at Meeting

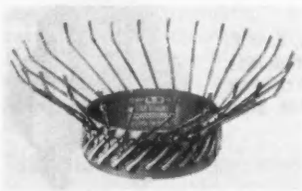
Nearly 1000 petroleum production and drilling engineers and executives will attend the annual meeting of the Petroleum Branch, AIME, in San Antonio October 5-7. Aspects of drilling and production technology ranging from aerial exploration to latest research discoveries of petroleum and natural gas behavior will be discussed in a program containing 37 technical papers and five non-technical addresses by industry executives.

Host for the meeting will be the Southwest Texas Local Section of AIME, of which Raoul Bethancourt, Sun Oil Company, Corpus Christi, Texas, is the chairman. Harold Decker, vice president of Pan American Production and Gas Companies, Houston, is the meeting chairman. Lloyd E. Elkins, production research director of Stanolind Oil and Gas Company, Tulsa, as branch chairman, will preside over several of the sessions. The technical program was assembled by a committee headed by Paul Turnbull, La Gloria Corporation, Corpus Christi; Morris Muskat, Gulf Research and Development Company, Pittsburgh, and Lincoln Elkins, Sohio Petroleum Company, Oklahoma City.

Insure Better Cement Jobs *BEFORE* Cementing!



B and W Latch-On Centralizer



B and W Multi-Flex Scratcher

IT'S EASY TO KNOW ahead of time that you're going to get a better cement job . . . that you'll avoid need for squeeze cementing . . . that you'll have a more profitable well completion—*and at just a fraction of the cost of having a cementing failure on your hands!*

First—*Centralize the casing* with simple, easy-to-install B and W Latch-On Centralizers. Effective casing centering eliminates channeling in the cementing zone and insures the best possible cementing bond between casing and hole wall. Latch-On Centralizers are of split hinge construction to permit quick, money-saving installation on either collared or external upset casing, and are made in straight and spiral types for all well conditions.

Second—*Remove mud cake* with B and W Multi-Flex Scratchers installed on the casing through the desired cementing area. Strong multiple-wire fingers 5" long combine strength with reversibility . . . are flexible to adapt themselves to hole contour for minimum disturbance of the mud cake while running in . . . insure *complete mud removal* during cementing.

We'll gladly supply full information on how you can use this B and W equipment for better well completions. Write today.

Don't Squeeze! **. . . it CAN be avoided**

B and W Incorporated

★ *Well Completion Specialists* ★

P. O. Box 5266, Houston 12, Texas • 3545 CEDAR AVE., LONG BEACH 7, CALIF.
Export Representative: Champion & Smith, Inc., 617 S. Olive St., Los Angeles 14, California, 10 Rockefeller Plaza, New York 20, N. Y.

Tulsa Geophysicists Choose Officers and Committeemen

W. T. Born, Geophysical Research Corporation, has been elected president of the Geophysical Society of Tulsa for the 1949-50 term. Other new officers include E. M. McNatt, The Carter Oil Company, and N. J. Christie, United Geophysical Company, first and second vice presidents, respectively; N. R. Sparks, Stanolind Oil and Gas Company, secretary-treasurer.

Committee members include, program, McNatt, chairman, F. F. Campbell, W. H. Courtier, J. D. Eisler, J. P. Garner and E. V. McCollum; publicity, Paul L. Lyons, chairman, H. M. Thralls, Charles Deegan and William Erdahl; arrangements and entertainment, Christie, chairman, V. L. Jones, J. R. Maxey and Nash Miller; special committee on revision of by-laws, Glen Lambery, chairman, and R. Claire Coffin.

Texas Company Fellowship Is Established at Duke

The Texas Company is establishing a fellowship at Duke University to encourage graduate studies in physics, W. M. Nielsen, chairman, Department of Physics, announced.

Investigations will employ the methods of microwave spectroscopy—techniques that make possible accurate determination of the molecular forms of the simple hydrocarbons from which much can be deduced about the chemical bonding of more complex hydrocarbons.

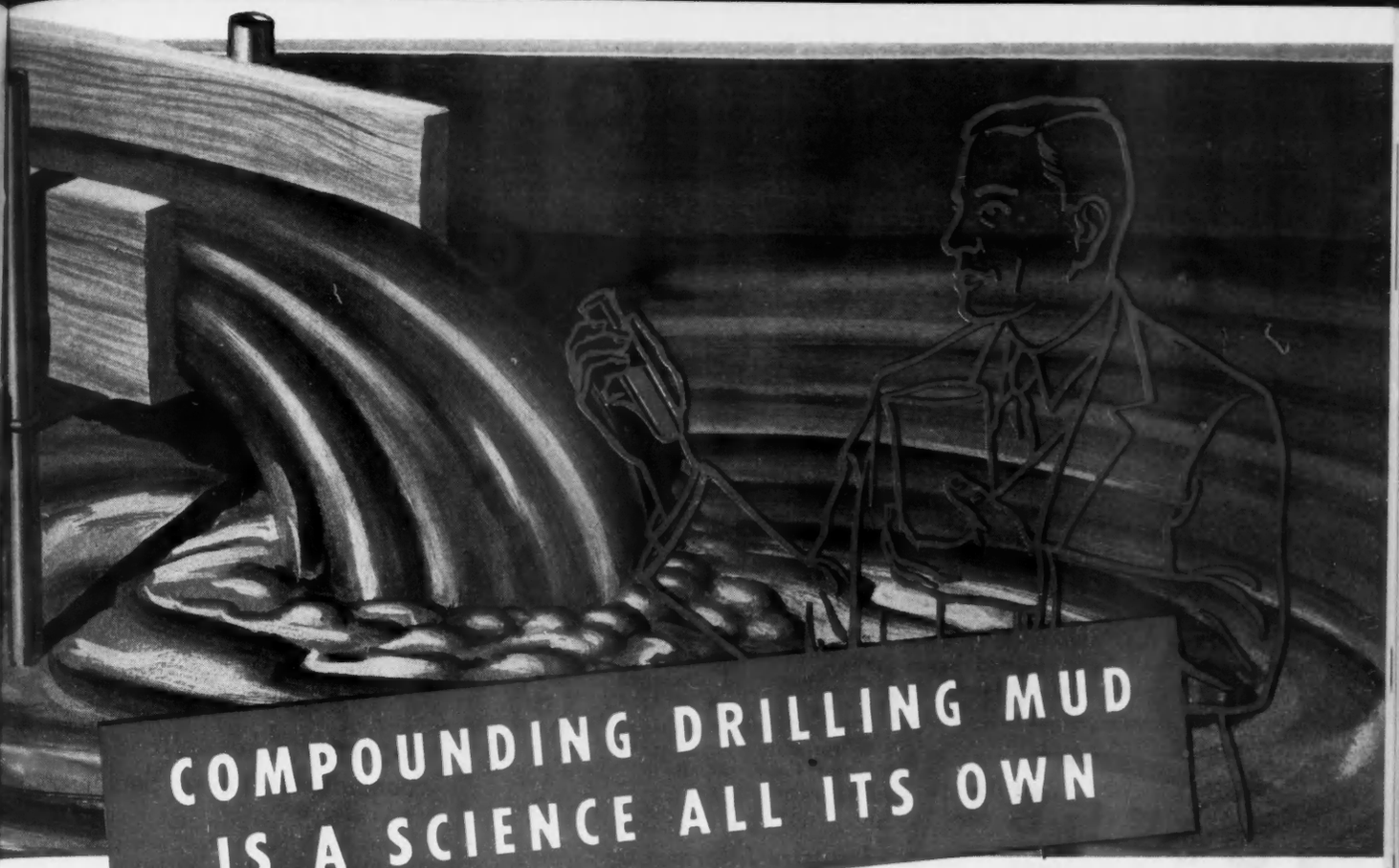
Geological Survey Scientist Receives Honorary Degree

The University of Arkansas has conferred upon Dr. Hugh Dismore Miser, staff scientist of the U. S. Geological Survey, the degree of doctor of laws.

Dr. Miser was graduated from the University of Arkansas in 1908. Since 1911 he has been a member of the Geological Survey except for short periods in 1920, when he was state geologist of Arkansas and acting professor at the University of Arkansas, and in 1926 when he was state geologist of Tennessee.

Past Presidents Honored By Production Pioneers

Presentation of gavels was made to past presidents of Petroleum Production Pioneers at a meeting of the board of directors held in the new club rooms of the Petroleum Club. Henry Grinnell, vice president of the Key Contractors, Inc. and first president of the group, was the first to be honored. James Gosline Standard Oil Company of California also received a gavel.



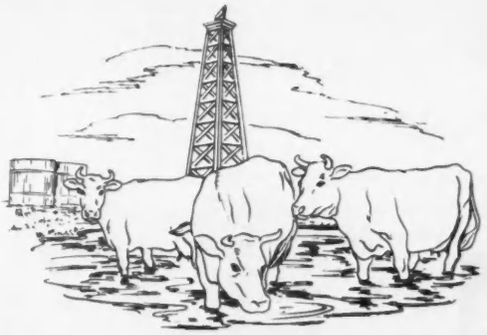
COMPOUNDING DRILLING MUD IS A SCIENCE ALL ITS OWN

Through chemistry, modern drilling muds that throb through flow lines and play such a vital role in today's deep, high pressure oil wells have evolved into a complex, specialized science all their own.

As an example, the carefully compounded and controlled drilling muds used in deep Gulf Coast wells today are a far cry from the earth-and-water muds used in early discovery wells that established the Gulf Coast region as one of the world's most prolific, high pressure oil producing areas.

History records . . . and many an old-timer is still around to confirm it . . . that mud used in the Spindletop well was actually siphoned from a near-by mud hole, agitated by cows wallowing and tramping through the mire.

Drilling muds and chemicals have become an increasingly important part of the drilling operation. Drilling muds and chemicals to meet the multitude of problems encountered in today's deep, high pressure wells are developed in modern laboratories by skilled chemists. Each new chemical . . . each new refinement to drilling muds . . . is developed only after exhaustive research and tests.



Magcobar has met this challenge by providing the oil industry with a complete drilling mud and chemical service. This includes modern laboratories and skilled personnel for product development and quality control, and capable field engineers in laboratory-equipped cars with two-way radio to give prompt assistance at the rig.

Yes, through chemistry, modern drilling muds have progressed far beyond the earth-and-water stage. Look for the Magcobar sign when you need mud. There are more than 250 Magcobar dealers from Canada to Florida who are ready to serve you night and day with complete drilling mud service.

MAGNET COVE BARIUM CORPORATION, Malvern, Arkansas; Houston, Texas

Export Representative: Daniels, Beckley and Associates, 30 Rockefeller Plaza, New York 20, New York.

Look for this sign **WHEN YOU NEED MUD**

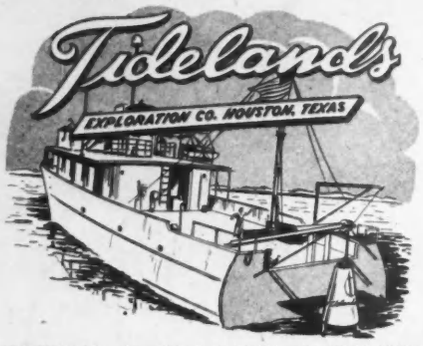
MAGCOBAR • MAGCOGEL • HIGH YIELD DRILLING MUD • XACT CLAY • FIBER-SEAL • MAGCO-MICA • TANNATHIN • JEL-OIL MUD • JEL-OIL "E" • SALT GEL • NOHEEV • SEAL FLAKES • MY-LO-JEL • CHEMICALS

Magcobar

Complete

DRILLING MUD SERVICE

DEALER



SEISMIC & GRAVITY SURVEYS

ON LAND AND SEA – FOREIGN AND DOMESTIC

● Assured positive results . . . based on years of practical experience performing geophysical surveys delineating oil structures.

John L. Bible Ray St. Germain U. E. Neese

TIDELANDS EXPLORATION CO.

2626 Westheimer Houston, Texas

* IN CANADA: Calgary, Alberta, Canada
Phone: MAIN 4924 513 - 6A St. NE

DIESEL

JACKET WATER

STABILIZATION

Maintain effective cooling . . . eliminate scale formation . . . prevent pitting and corrosion by stabilizing your Diesel Jacket Water. We offer reliable stabilization by intelligent application of standard methods. Phone, write, wire for further information.

25 Years Successful Experience

GULF ENGINEERING CO., INC.

"Service Not Promises"

1692 [illegible] SOUTH ST.
HOUSTON, TEXAS

916 S. PETERS STREET
NEW ORLEANS, LA.

Gravity Surveys

COASTAL OIL FINDING COMPANY

Established 1928

ESPERSON BLDG. HOUSTON, TEXAS

Trading Post Ahead Page 300

ASSOCIATIONS

Union Oil Plans Museum of West Coast Oil Industry

Formation of an oil museum to be located in the original Union Oil building in Santa Paula, Calif., was announced by Reese H. Taylor, president of the company. The entire ground floor of the building will be given over for an historical display of oil industry equipment, photographs, documents and other material pertaining to the development of the industry in the West.

Historic material will be sought from all sources either on a loan basis or as an outright donation to the museum. Geological, exploration, production, transportation, refining and marketing exhibits are hoped to be included along with historical documents and photographs.

It is anticipated that the museum will be formally opened in 1950 as a part of Union Oil Company's Sixtieth Anniversary celebration.

Industry Information Group Names Education Coordinator

David Randolph Salmon has joined the staff of the Oil Industry Information Committee in New York as educational coordinator. Salmon was director of Education and Industry for the National Association of Manufacturers prior to his affiliation with the OIIC.

A graduate of Cornell University, Salmon also holds a degree of Master of Education in Administration from the Harvard Graduate School.

Youngstown Safety Director Named to Indiana Council

Harvey G. Hensel, safety director for the western district of The Youngstown Sheet and Tube Company, has been appointed a member of the General Advisory Council to the Indiana Division of Labor by Governor Henry F. Schricker.

The council, composed of equal representatives from employers and employes, studies and promulgates codes and rules for safety and health in all places of employment in the state.

Leighton Is Chosen Head of Economic Geologists Society

Dr. Morris M. Leighton, chief of the Illinois State Geological Survey, Urbana, Ill., has been named president-elect of the Society of Economic Geologists for 1950-51.

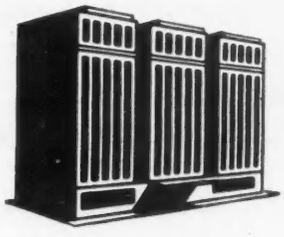
Dr. Leighton last fall completed his 25th year as chief of the Illinois Survey. Previously, he taught geology for seven years at the universities of Washington, Ohio State and Illinois.

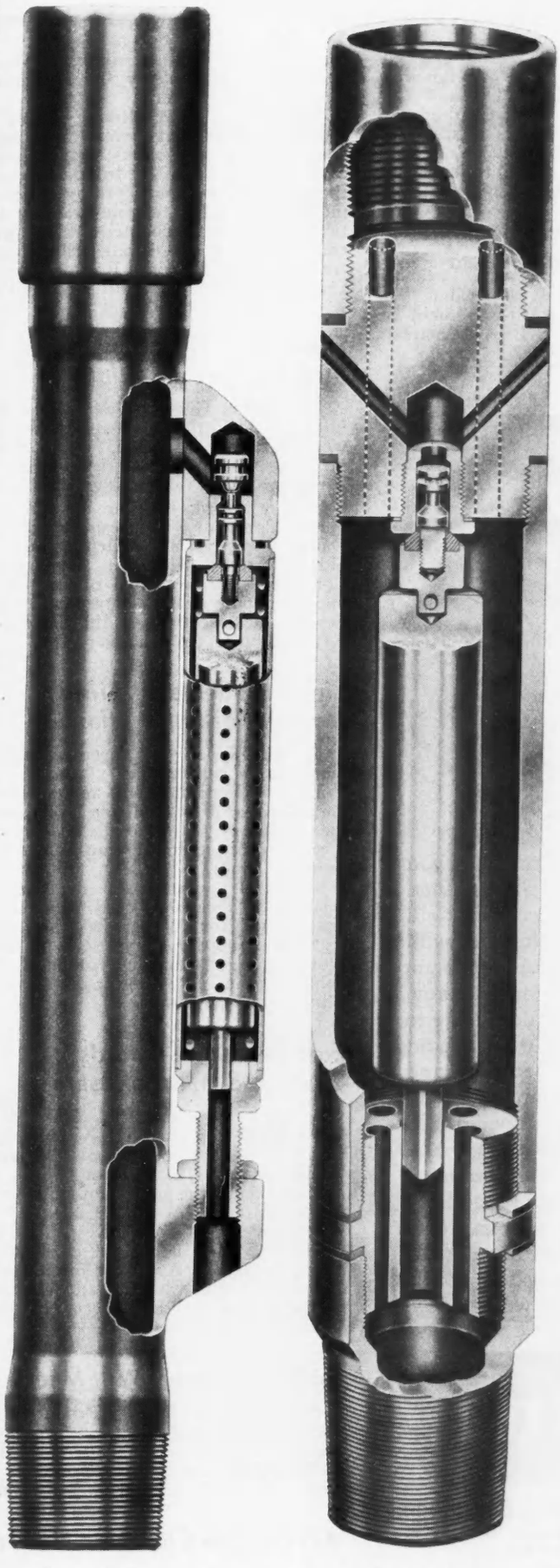
SKIRVIN HOTELS

Welcome to the Skirvin

Oklahoma City

One Of The Nation's Traditionally Fine Hotels.





Pat. Pending

Pat. Pending

Replace Those Jet Collars
WITH

NIXON
"Weight Loaded"
GAS LIFT FLOW VALVES

★

—Save Input Gas
—Increase Production

Operators who have wells now producing thru Jet Collars with a high gas-oil ratio, will welcome the new Nixon "Weight Loaded" Gas Lift Flow Valves—for every well in which they have been run—input gas volume has been reduced to a great extent.

In many instances a major increase in production has occurred.

The new Nixon "Weight Loaded" Gas Lift Flow Valves are made for both Constant Flow and Intermittent Flow. The Intermittent Flow Valves are recommended for wells producing a small volume of fluid.

These new valves are simple in design and have no parts which fail thru fatigue. They remain in calibration throughout their long life. Can be completely serviced in the field.

★

—for Tubing Flow

For medium and high Producing Fluid Level Wells, where the amount of fluid to be produced does not exceed the capacity of the tubing—Nixon "Weight Loaded" Gas Lift Tubing Flow Valves are recommended. (Shown at far left.)

—for Casing Flow

When wells are located in heavy water drive fields, where it is necessary to produce more fluid than can be handled thru the tubing, Nixon "Weight Loaded" Gas Lift Casing Flow Valves really do the job. (Shown at left.)

★

If you are interested in these NEW "Weight Loaded" Differential Gas Lift Flow Valves—write for complete information contained in a 24-page illustrated booklet giving installation and operating data. Address:

WILSON SUPPLY COMPANY, GAS LIFT DEPARTMENT
P. O. Drawer 19, Houston, Texas, or contact your nearest Wilson Supply Store.

WILSON SUPPLY COMPANY

1412 MAURY ST., HOUSTON, TEXAS

SALES OFFICES: Tulsa, Okla.; Dallas, Texas.
Foreign Rep.
CHAMPION & SMITH, INC.
10 Rockefeller Plaza, New York 20, N. Y.
617 S. Olive St., Los Angeles 14, Calif.

BRANCH STORES: TEXAS—Kilgore, Beaumont, Barbers Hill, Bay City, Monahans, Alice, Victoria, Corpus Christi, Columbus. LOUISIANA—Lake Charles, New Iberia, Harvey, Shreveport, Houma. ARKANSAS—Magnolia.

API Information Department Assistant Director Named

H. J. Struth, oil economist and analyst, has been appointed assistant director of the API Department of Information, succeeding Robert E. Allen, resigned. Struth will work under the direction of H. B. Miller, director of the department, and will serve as his administrative aide in the functioning of the department.

Struth joined the Institute staff last January, going to New York from Dallas, where he originated and edited the first two editions of the *Petroleum Data Book* for the Petroleum Engineer Publishing Company. He was formerly with the Mid-Continent Oil and Gas Association as an economist and administrative aide for ten years. During the NRA days of the early 1930's, he was technical adviser to the Petroleum Administrative Board in Washington.

AAODC Holds Drilling Engine Training School at Odessa

The first of a series of Drilling Engine Training Schools was held in Odessa, Texas, with J. A. Boatman, formerly with Rowan Drilling Company and now employed by Odessa public schools, as instructor.

Designed to offer drilling crews in the West Texas and New Mexico areas a thorough course of instruction in the care and operation of drilling engines, these schools are sponsored by the committee on drilling engine training for the Permian Basin chapter of the American Association of Oilwell Drilling Contractors. Cecil Provine, Rowan Drilling Company, is chairman of this committee.

Exploration Geophysicists Plan Meeting in Dallas

The Dallas Geophysical Society and the Fort Worth Geophysical Society will sponsor a regional exploration meeting at the Adolphus Hotel in Dallas Thursday and Friday, November 17-18.

O. C. Clifford, Jr., The Atlantic Refining Company, is president of the Dallas Geophysical Society, and Dr. Sidon Harris, Southern Geophysical Company, is president of the Fort Worth Geophysical Society. Both societies are local sections of the Society of Exploration Geophysicists.

Lippert Is Selected AIME Manager of Publications

T. W. Lippert has been appointed manager of publications, AIME, New York. The Institute owns and publishes the *Journal of Metals, Mining Engineering*, the *Journal of Petroleum Technology* and a variety of technical transactions and technical books.

Lippert is a graduate of the Carnegie Institute of Technology, B.S. and M.S. in physics, and for 16 years was associated with the *Iron Age*, New York, in latter years serving as directing editor of that publication and as a director of the parent Chilton Company, Inc.

East Texas API Awards Texas A.&M. Scholarship

A two-year scholarship financed by the East Texas Chapter, API Production division, has been awarded to James Kelly Elliott, 19, of Overton, Texas. He has enrolled in the petroleum engineering school of Texas A. & M. College.

Announcement of the award was made by Phil J. Lehnhard, chairman of the Scholarship Awards Committee of the East Texas Chapter, and chairman of the East Texas Engineering Association.

Valley Producers Will Meet

San Joaquin Valley Oil Producers Associations will hold its mid-year meeting on October 12 at Bakersfield Inn, Bakersfield, Calif. Speakers will be Walter S. Hallanan and E. DeGolyer.

API Division Chairman Named

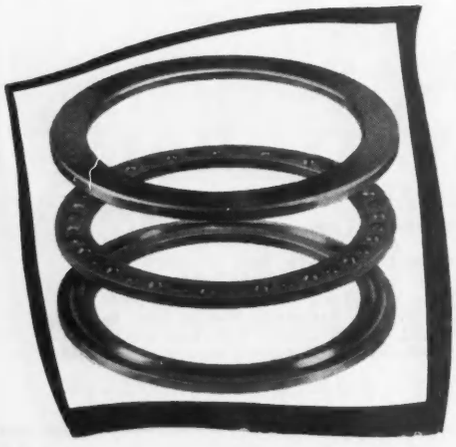
Zack M. Brinkerhoff, Jr., drilling contractor, Denver, has been elected chairman of the Rocky Mountain division, API.

Ideco Streamlined Swivel—Model SS 300—with upthrust bearing by Aetna. Special Aetna bearings are available in sizes up to 38" O.D.

If you're engineering-minded, you can see that this Ideco Streamlined Swivel is engineered for strength without bulk, for peak efficiency with minimum maintenance, for maximum life expectancy.

These are advantages which come to any hard working equipment when Aetna bearings lend a hand. Aetna bearings and oil country equipment are teammates of long standing because of Aetna's specialized experience in heavy duty applications and ability to manufacture to extreme quality standards.

Worthwhile savings and improvements in the equipment YOU build might result from a talk with Aetna. Call or write today!



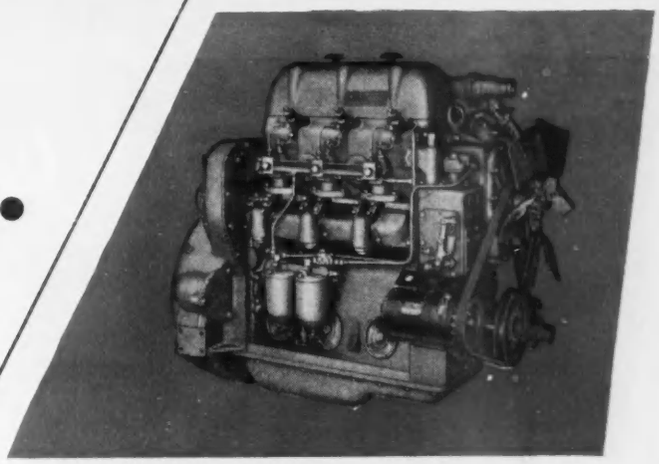
Aetna

AETNA BALL AND ROLLER BEARING CO.
4600 Schubert Ave. • Chicago 39, Ill. • Phone CApitol 7-2410

Standard and Special Ball Thrust Bearings • Angular Contact Ball Bearings • Special Roller Bearings • Ball Retainers • Hardened and Ground Washers • Sleeves • Bushings

Proved...

for your tough jobs!

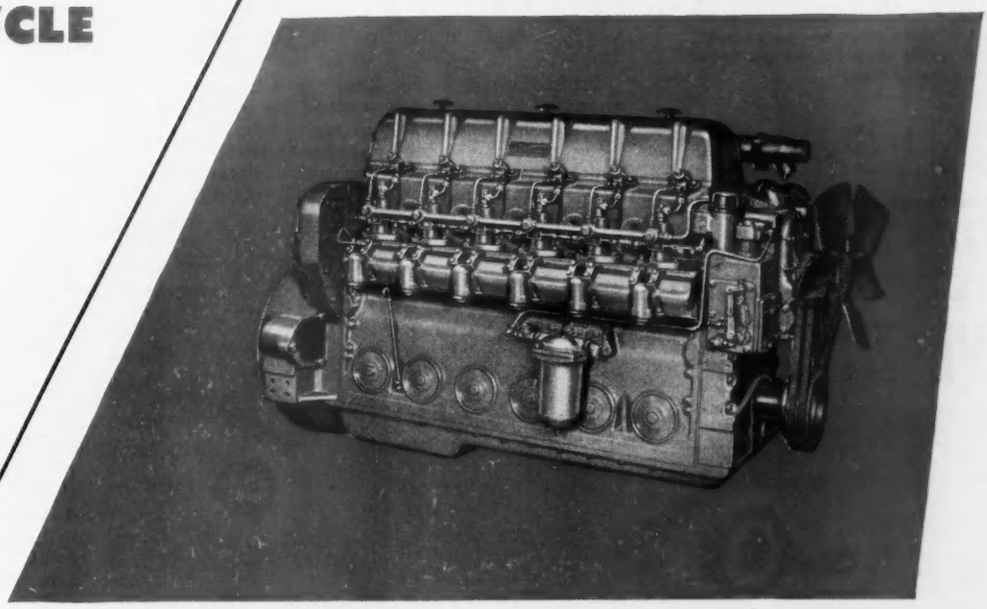


Model 387-C 3 cylinder

P&H DIESELS

2 CYCLE

Model 687-C 6 cylinder



Built for the toughest job known

Now — the new P&H Diesels are ready — after years of intensive research, development and testing in the most grueling of diesel applications — excavator service.

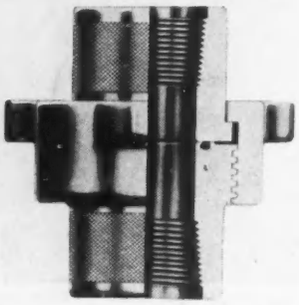
The new P&H Diesels introduce a number of advancements in design — in performance — and in easier servicing — which will be welcomed in many fields of diesel usage, mobile, stationary and marine.

Literature is now available. Address Harnischfeger Corporation, Diesel Division, Port Washington, Wisconsin.

P&H DIESEL DIVISION HARNISCHFEGER CORPORATION

EXCAVATORS · ELECTRIC CRANES · ARC WELDERS · HOISTS · WELDING ELECTRODES · MOTORS

For GAS



It's the YALE UNION

You'll be amazed at the ease with which YALE UNIONS seal against gas . . . or against fluids, vapors, steam or vacuum. No sealing method ever designed provides easier, faster, more positive pressure seals than the O-Ring in YALE UNIONS.

Try one just once . . . you'll use nothing but YALE UNIONS thereafter. Available in all popular sizes, for working pressures from 500 to 7500 psi. If your supply store can't furnish, order direct, giving the name and location of your favorite supply house.

YALE MACHINE WORKS

4403 Yale Street Houston, Texas

Export: R. S. Stokvis & Sons, Inc., 17 Battery Place, New York, N. Y.

SAVE TOOL JOINTS DRILL COLLARS

Bill Womble's ZINC COMPOUND

- Stops joint leakage, washouts and galling
- Prevents freezing of tool joints and drill collars
- Eliminates thread corrosion *wherever threads are used!* *Proved in the lab and on the rig.*

Ask for Bill Womble's Zinc Compound at your supply store or oil dealer . . . or write—

Bill Womble

404 Staley Bldg. Wichita Falls, Tex.

508A M & M Bldg. Houston 2, Tex.

Men in the Industry NEWS

Robert G. Martin

Joe A. Huitt

Joe A. Huitt has been appointed manager of Deep Rock Oil Corporation's Purchasing department, replacing **Robert G. Martin,** who retired October 1 following 31 years of service with the company as a purchasing agent, except for three years during which he was a clerk and warehouseman at the Cushing, Okla., refinery.

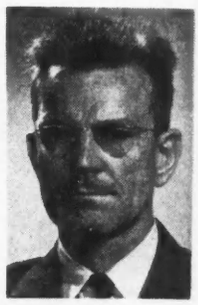
Huitt joined Deep Rock as a roustabout in 1929, and has worked up to his present appointment through jobs as clerk, warehouseman, superintendent of shops and transportation, and assistant to Vice President R. K. Huey of the Production department.

R. W. Gemmer has been promoted to chief geophysicist for The Carter Oil Company, succeeding **Dr. A. B. Bryan** now with the Production Research department of Standard Oil Development Company. Before joining Carter in 1935, Gemmer was on the geophysical staff of Humble Oil & Refining Company, Houston, for nine years, during which time he was instrumental in development of the Blau-Gemmer method of electrical logging. Since 1947 he has been assistant chief geophysicist for Carter.

R. W. Gemmer

L. F. McCollum, president of Continental Oil Company, of New York and Ponca City, Okla., was accompanied on an aerial trip to Canadian oil fields early in September by **W. C. MacMillan,** administrative assistant to the president, of Ponca City. **R. C. Brown,** vice president and general manager, and **G. H. Bowes,** exploration manager, both of Hudson's Bay Oil & Gas Company, Canadian subsidiary of Continental, joined the party in Calgary for a general inspection of the company's production operations in Turner Valley, Leduc, Redwater, Viking-Kinsella, and Lloydminster.

Dr. M. King Hubbert, associate director for exploration at Shell Oil Company's Exploration and Production Research Laboratory in Houston, was a delegate to the United Nation's Scientific Conference on Conservation and Utilization of Resources.



Dr. M. King Hubbert

Dr. Hubbert joined Shell in 1943, and was appointed to his present position two years later. He was graduated from the University of Chicago where he received B.S., M.S. and Ph.D. degrees. Prior to joining Shell he was a lecturer at Columbia University, worked with the U. S. Geological Survey and, during the war, as a member to the Board of Economic Warfare.

Dr. W. A. Bruce and **Dr. E. M. McNatt** have been named assistant chiefs of research of The Carter Oil Company at Tulsa, Okla. **Dr. M. W. Kriegel,** a Carter scientist since 1940, has been named head of exploitation research, replacing Dr. Bruce, and **Dr. R. R. Thompson,** New York, senior geophysicist with the Standard Development Company, has been appointed head of geophysical research, replacing Dr. McNatt.

Specify PELCO Welding Saddles

PELICAN WELL TOOL & SUPPLY CO.

P. O. Drawer 1108
Shreveport (84), La.

SEE YOUR NEAREST SUPPLY HOUSE

Enginaired Controls add the

MODERN TOUCH

to

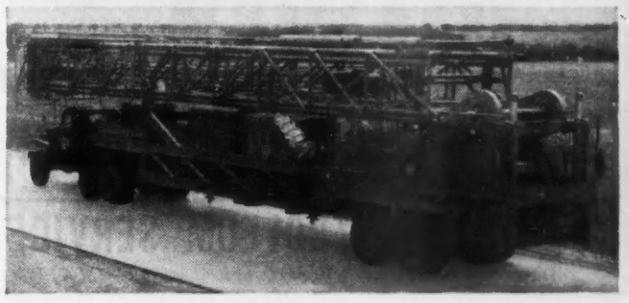
CARDWELL TRAILER RIGS

You'll find a lot of attractive modern touches on the new Cardwell Rigs—and among them the newest thing in W·A·B Engin*aire*d Controls. Instead of the clutter and complication of mechanical linkage, command of all operations is concentrated in a few rugged, dependable W·A·B control valves. The clean, attractive overall design is repeated in the treatment of the control stand, where the manufacturer has machined suitable slots for the Westinghouse Flexair valves in the streamlined cover panels.

The use of W·A·B devices on Cardwell Rigs literally brings a *modern touch* to control operations, for only a finger touch is needed to operate the control valves, and initiate any action. These modern controls add a definite plus to the many advantages of these famous oil-field performers.

Westinghouse Air Brake Co.

Industrial Division . . . WILMERDING, PA.



The Cardwell Trailerig design concentrates a full-scale draw works into a machine only 8-feet wide, 13½-feet high, and 59-feet long, when in roading position. Extreme mobility is one of the important modern features of this unit. W·A·B controls are also used on Model O Draw Works and other Cardwell drilling and servicing units.

E. E. Rehn, former division geologist for the Western division of Sohio Petroleum Company in Oklahoma City, has returned to Evansville, Ind., to operate as an independent and consulting geologist in the Tri-State area. His Evansville offices are at 308 Grein Building.

E. E. Rehn

Joe A. Laird has joined the staff of the Petroleum Engineering department of the Agricultural and Mechanical College of Texas as assistant professor of petroleum engineering. Laird received his B. S. degree in petroleum engineering in 1940 from A. and M. College of Texas. He spent one year with Jo H. Cable as petroleum engineer; for 2½ years he served as petroleum engineer with the Oil and Gas division of the Texas Railroad Commission. He was geologist and petroleum engineer for **George W. Strake** for 3½ years, at the end of which he entered the University of Oklahoma and received his masters degree in geology and petroleum engineering in 1947. For the past two years he served as an independent geologist and petroleum engineer in Houston.

J. J. Arps, formerly chief engineer and assistant general superintendent of The British-American Oil Producing Company, has been appointed to the new position of manager of production research and economics.

J. J. Arps

Arps was formerly a petroleum engineer with Shell Oil Company, and joined The British-American in December, 1940, as district engineer and later as district superintendent for the Gulf Coast area. He was later made chief engineer in the Tulsa office, a position he held until his present appointment.

Edward H. Mutz has been elected vice president of Sinclair Oil Corporation. Mutz joined the Sinclair organization in 1920 at Philadelphia and in 1923 was transferred to the New York office, where he worked in the Treasury department. In 1943 he was elected assistant treasurer, a position he holds in addition to being vice president.

William F. Bramstedt has been elected executive vice president and a director of the Caltex-Bahrein group of companies. He was formerly a vice president of California Texas Oil Company, in charge of crude oil marketing, before becoming president of Mid-East Crude Sales Company Limited in September, 1948. He was graduated in mechanical engineering at the University of California.

William F. Bramstedt

E. V. Watts has been appointed production superintendent of the Southern division of General Petroleum Corporation's Production department. Watts has been assistant to C. C. Gandaubert, Southern division superintendent.

He took a B. S. degree in engineering at the California Institute of Technology in 1936 and joined General Petroleum Corporation the same year.

His first position was as a roustabout in the Lost Hills field. Within a year he had advanced to engineer at the company's Vernon headquarters. He has been assistant to the division superintendent since May, 1948.

Here's a little Booklet

with a lot of information on how to CUT MAINTENANCE CLEANING COSTS

Send for your **FREE** *copy today!*

This 32-page booklet is packed with job-tested data on "in-place" cleaning of stabilizing, fractionating, absorption towers; on "in-place" cleaning and descaling of heat exchangers; on cleaning and de-rusting barrels and drums for re-use; on cleaning in connection with salvaging; on the cleaning of tank car interiors and many other regularly scheduled maintenance cleaning operations.

The scientific Oakite cleaning methods described in this booklet have proved successful money-and time-savers for many of the nation's leading petroleum producers, refiners and marketers. Get your FREE copy today! No obligation, of course. Oakite Products Inc., 37 Thames Street, New York 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE 1909 1949 40th ANNIVERSARY YEAR

OAKITE

TRADE MARK REG. U. S. PAT. OFF.

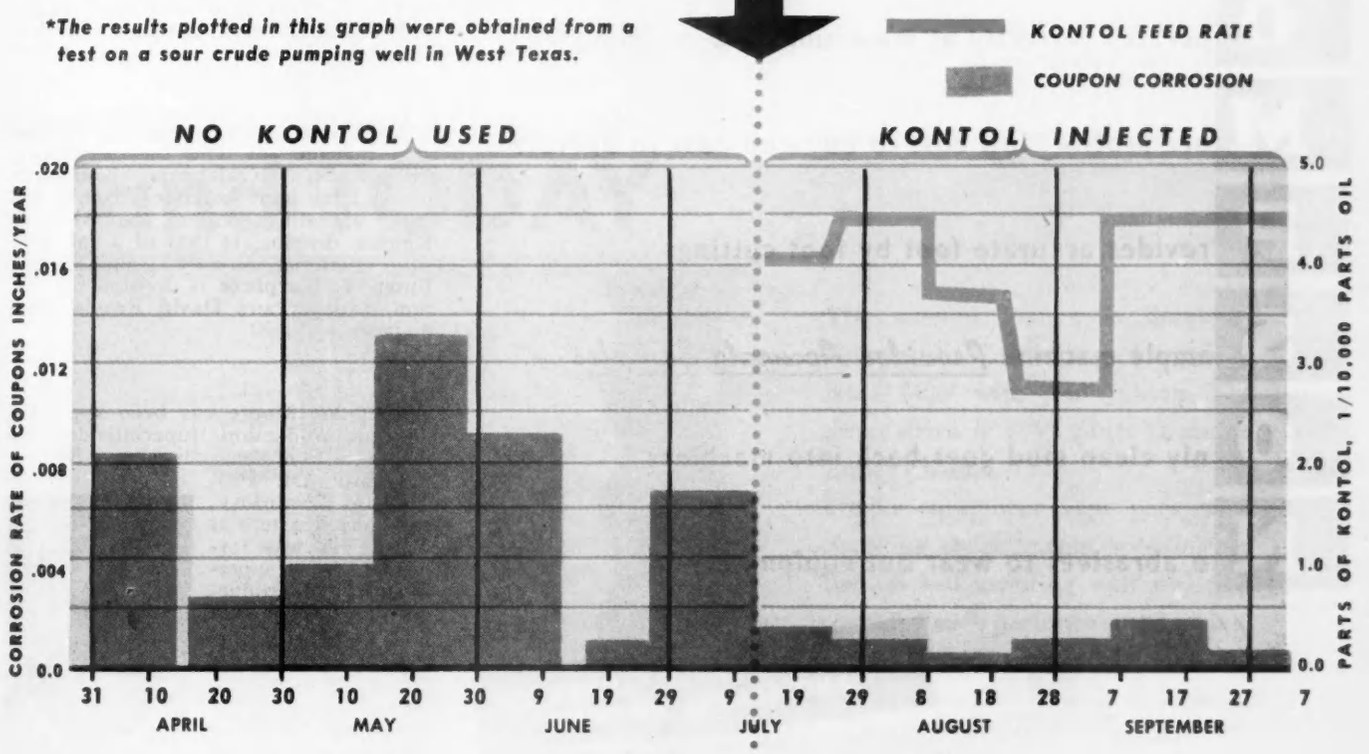
PETROLEUM SERVICE DIVISION

KONTOL

CORROSION PREVENTIVES TELL THEIR OWN STORY

KONTOL corrosion preventives were specifically developed by the Tretolite Company to combat corrosion in sub-surface oil and gas well pumping equipment. KONTOL forms a strongly adsorbed film on metallic surfaces, preventing attack by corrosive elements. The chart below records typical results of one of the many KONTOL field tests,* and graphically demonstrates KONTOL effectiveness.

The results plotted in this graph were obtained from a test on a sour crude pumping well in West Texas.



For informative literature, further information and particulars on the Kontol Rate of Corrosion Test Service, write or call

TRETOLITE COMPANY

Manufacturing Chemists

ST. LOUIS 19, MISSOURI • LOS ANGELES 22, CALIFORNIA

KONTOL

CORROSION PREVENTIVES

KG-49-4

David E. Spencer has been appointed petroleum engineer by the Department of Natural Resources and Industrial Development, Province of Saskatchewan, Canada. Spencer was formerly gas inspector in the department. He studied engineering at the University of Saskatchewan, and served as a captain in the Royal Canadian Artillery during the war.

Frederic E. Hanes is geologist for the department. He is a graduate in geological engineering from the University of Saskatchewan. Hanes formerly worked for **Professor F. H. Edmunds** of the university, doing core logging, correlation and map work and surveying as assistant geologist in the Lloydminster field.

H. D. Brown, foreman, Cushing Tank Farm, Stanolind Oil Purchasing Company, was promoted to superintendent, Tankage and Terminal department with headquarters at Tulsa, succeeding **R. A. Forsman,** resigned. Brown had continuous service in the Tankage department since July 16, 1921.

T. W. Wheeler, formerly with Kerr-McGee Oil Industries, Inc., has assumed responsibilities in connection with the management of Lofland Brothers Company, and has moved to the company headquarters at Tulsa.

T. W. Wheeler

After receiving a degree in geology from the University of Colorado in 1928, Wheeler was first employed by Phillips Petroleum Company and assigned to general field work in the Mid-Continent area. Until 1939 he held various positions with Phillips, and became, prior to his resignation, general superintendent of the core drill division of the Geological department. From 1939 until 1943 Wheeler was a partner and later sole owner of a drilling company operating in South Dakota, Texas, Louisiana, Illinois and Indiana. In 1943 he became associated with Kerr-McGee and was assistant to the vice president in charge of drilling.

J. W. Thompson has been named division manager of The Bay Petroleum Corporation's Oklahoma operations, which have been expanded from a district operating under the Wichita, Kansas, division, to that of a full division operating directly from Denver. **Buren T. Murphree** is division production manager and **David Reavis,** chief division geologist.

Wesley W. Moore has been appointed general production superintendent of the Mid-Continent division, British-American Oil Producing Company, with headquarters at Tulsa. He was formerly district superintendent of production at Oklahoma City.

Wesley W. Moore

J. C. Bruce, former North Texas district superintendent, has been named superintendent of a new district consolidating the Kansas, Illinois and Oklahoma districts, with headquarters at Oklahoma City. **Paul T. Hayward,** formerly district superintendent of the Kansas district, Great Bend, has been appointed superintendent of the North Texas, West Texas and New Mexico districts, with headquarters at Seymour, Texas.

J. Marshall Nye has resigned as assistant manager of production for Sohio Petroleum Company, Oklahoma City, to become an independent operator and has been succeeded by **Walter McCloy, Jr.,** division superintendent at Evansville, Ind.

T hree sizes for shallow, medium, and deepest wells

H and lever assures simple operation

O perates perfectly at maximum flow or idling

M ore profits - low cost to buy - no cost to operate

P rovides accurate foot by foot cuttings

S ample machine *Provides Accurate Samples*

O nly clean mud goes back into machines

N o abrasives to wear out equipment

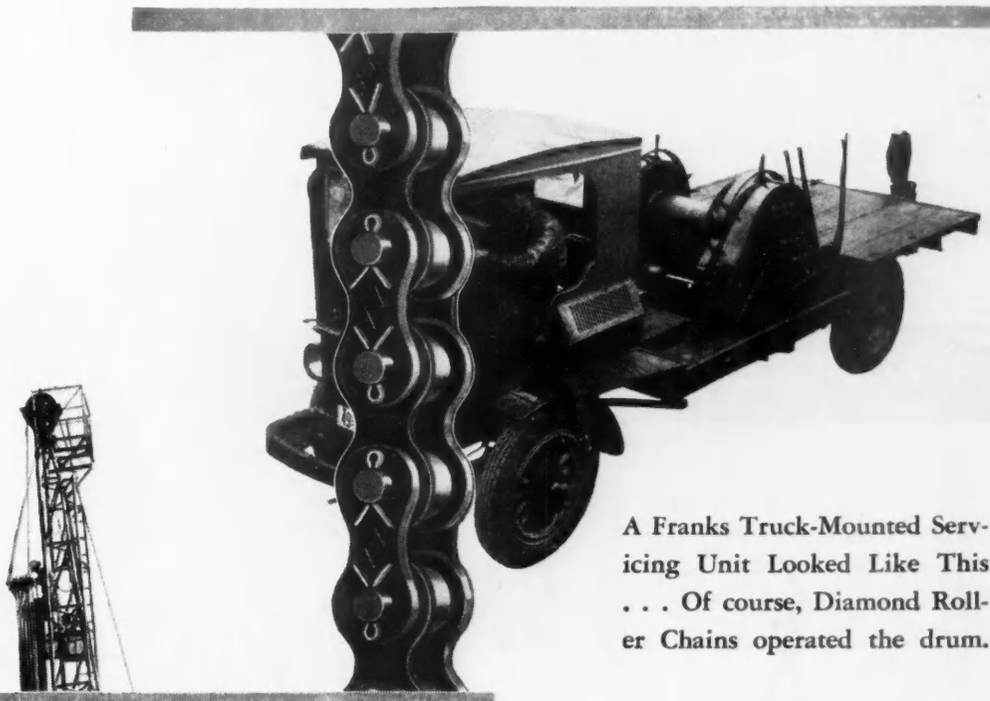
The screen drum is rotated by the precision power wheel which is turned by the mud flow discharge from the pumps. Built-in water-spray screen cleaning system may be supplemented by Electric Mud-Spray Screen Cleaning Attachment shown on model at immediate left and close-up at far left. The Electric Attachment is available separately for conversion of your Thompson machine.

THOMPSON TOOL CO.

P. O. BOX 357 PHONE 3521

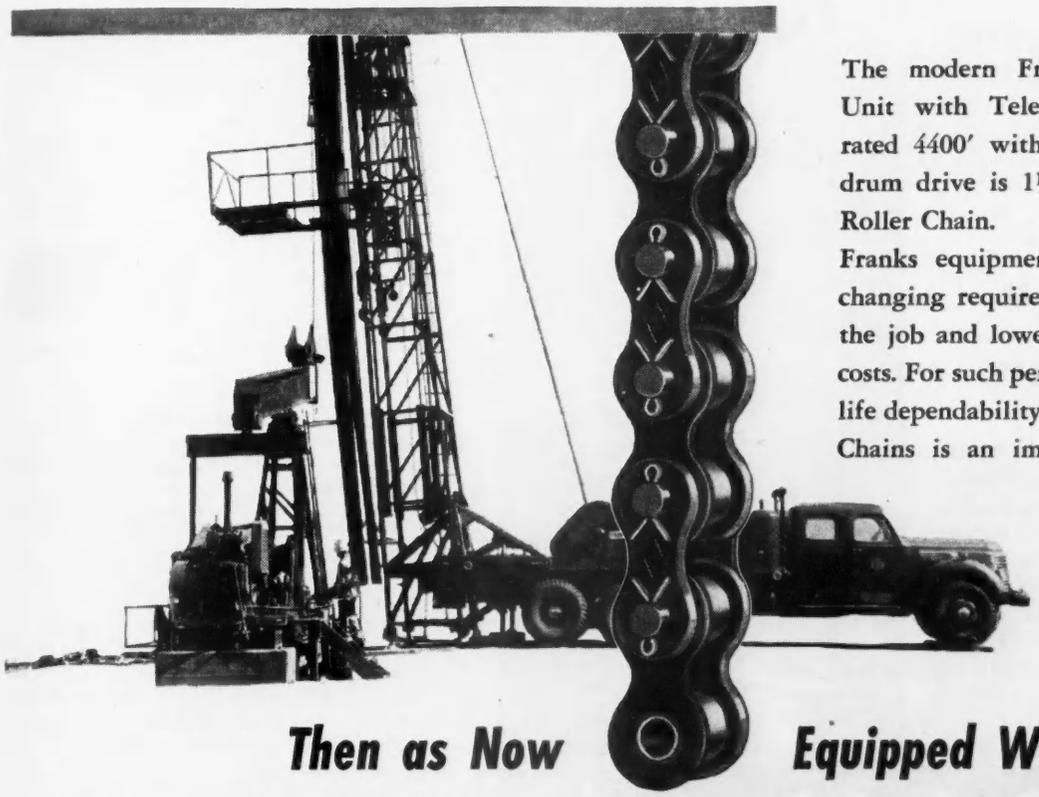
IOWA PARK, TEXAS

20 YEARS AGO



A Franks Truck-Mounted Servicing Unit Looked Like This . . . Of course, Diamond Roller Chains operated the drum.

and TODAY



The modern Franks 44 Servicing Unit with Telescoping Derrick — rated 4400′ with 2⅞″ tubing. The drum drive is 1½″ pitch Diamond Roller Chain.

Franks equipment kept pace with changing requirements, speeding up the job and lowering well servicing costs. For such performance, the long-life dependability of Diamond Roller Chains is an important advantage.

Then as Now Equipped With

DIAMOND ROLLER CHAINS

DIAMOND CHAIN COMPANY, INC.

Dept. 485, 402 Kentucky Ave., Indianapolis 7, Indiana
Tulsa Office: 2238 Terwilleger Blvd.

David W. Sellery, former Los Angeles division land man for The Ohio Oil Company, has been appointed division land man at Casper, Wyo. He succeeds **D. J. Griffin,** who was recently appointed district manager at Calgary, Alberta.

Paul S. Geiger, formerly a member of the Los Angeles Land department, has been promoted to the post of Los Angeles division land man.

Sellery joined the Ohio in 1925 as a scout in New Mexico. After several years as a leaser in New Mexico and California, he was appointed Los Angeles division land man in 1941.

Geiger entered the Land department as a draftsman in 1929 and became a land man in 1937.

Paul R. Turnbull has been named manager of the Drilling and Production department for La Gloria Corporation of Corpus Christi.

Turnbull holds a B.S. degree in petroleum engineering from Oklahoma University. He has been associated with Humble Oil & Refining Company for several years, his recent position being that of division petroleum engineer in the Southwest Texas division.

A. J. Welborn has resigned after 15 years with Gulf Oil Corporation to open an independent business specializing in oil leases, royalties and drilling blocks in the West Texas-New Mexico Permian Basin. Headquarters are at 3318 27th Street, Lubbock, Texas. Welborn has served with The Pure Oil Company, Oil Well Supply Company, Venezuela Gulf Oil Company, Texas-Pacific Coal and Oil Company, Simms Oil Company, and Gulf Oil Corporation. During World War II, he served for three years with PAW.

A. J. Welborn

Loren F. Kahle, president of Interstate Oil Pipe Line Company, Tulsa, has been granted an 18-month leave of absence to accept a temporary special assignment with Interprovincial Pipe Line Company, Ltd., of Canada, which is planning to build a 450-mile crude line from Edmonton, Alberta, to Regina, Saskatchewan.

Joseph L. Seger, formerly vice president and general counsel for Interstate, has been elected executive vice president of the company.

James C. Holmes, formerly in industrial relations and advertising work with Hotpoint, Inc., in Chicago, has been named editor of the *Log*, employe magazine of Deep Rock Oil Corporation, Tulsa. He received his B.S. and M.S. degrees in journalism from Northwestern University and has been editor of the *Hotpoint News*. From 1942 to 1945, he served with USAAF, including a tour of duty in the Southwest Pacific.

James C. Holmes

Maurice B. T. Davies has been appointed manager of Deep Rock Oil Corporation's Auditing department; **John W. Featherston, Jr.,** and **William F. Styler, Jr.,** have been named managers of the Accounting and Tax departments, respectively.

R. E. Copman has resigned as assistant secretary, general auditor and manager of the Tax department, Deep Rock Oil Corporation, Tulsa, to return to the general practice of public accounting and to specialize in income tax work.

Miss Irene Haskett, junior research physicist for The Carter Oil Company, Tulsa, is on a six-month leave of absence with Imperial Oil Company, Ltd., at Calgary, Alberta, Canada, where she is doing production research work.

For more efficient drilling...

Specify SPANG Cable TOOLS

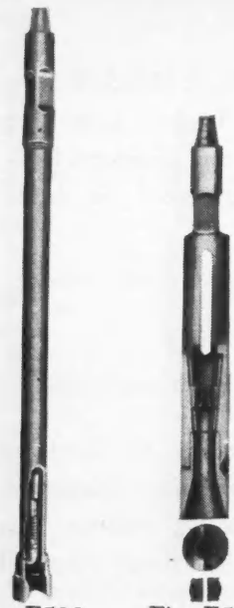
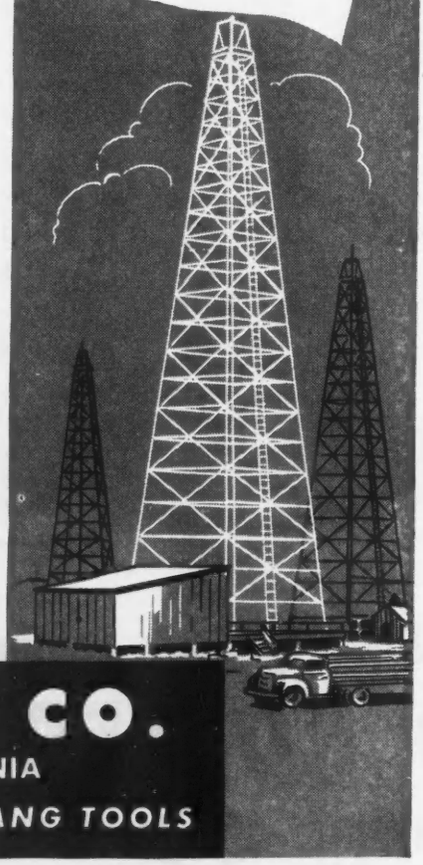


Fig. F533 Fig. F538

SPANG TUBING SPEAR
(Fig. F533)

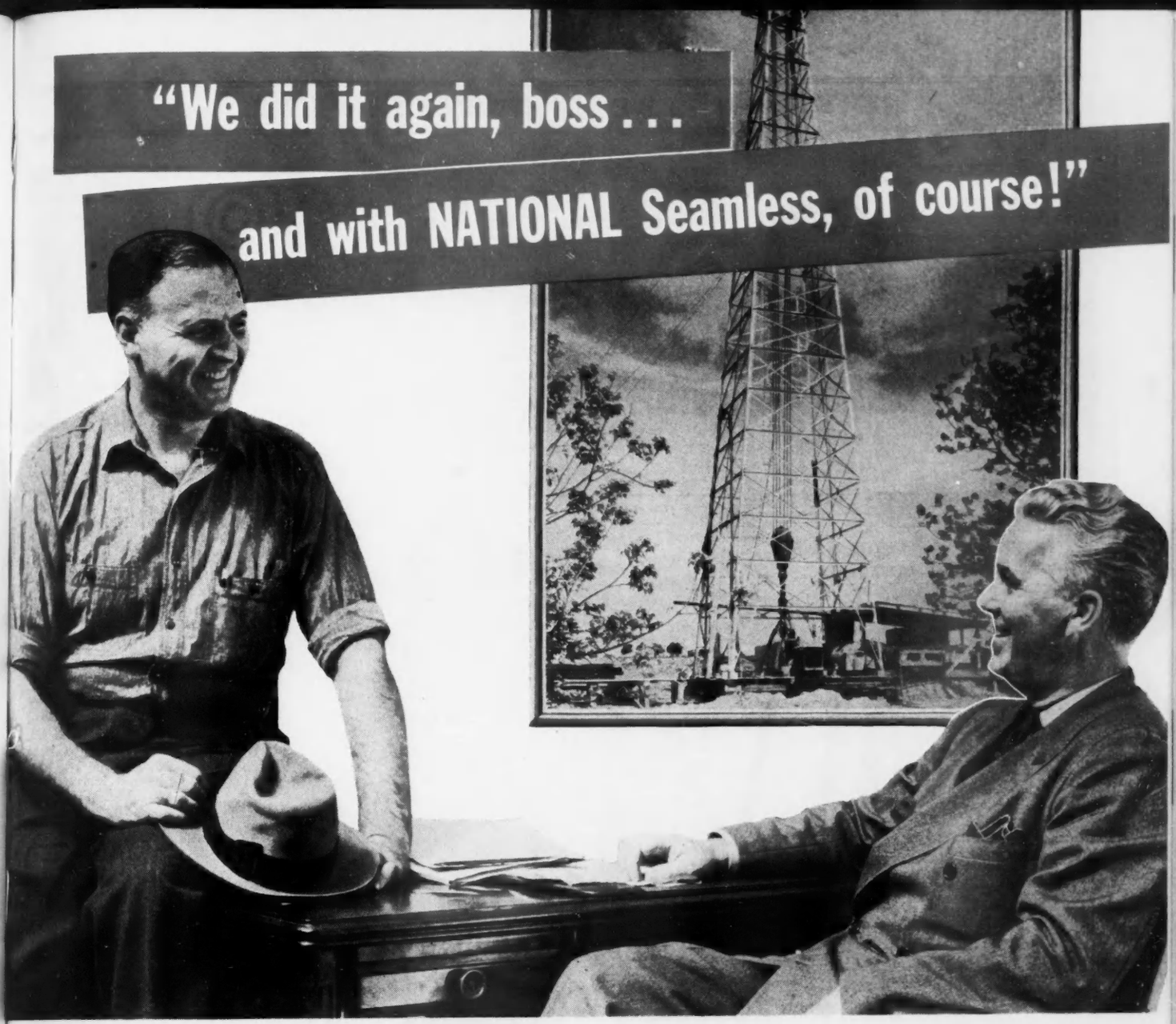
SPANG TRAP SOCKET
(Fig. F538)

FOR FISHING TUBING Spang offers a variety of tools, including Combination-Type Tubing Socket, Slip-Type Tubing Socket with mandrel, Cherry Picker, Spang Alligator Style Grab, Tubing Spears in a variety of types, and the Spang Trap Slip Socket (Ill.) which has a unique slip arrangement enabling it to catch tubing or slivers in almost any condition.



SPANG & CO.
BUTLER, PENNSYLVANIA
YOUR DEALER SELLS SPANG TOOLS

"We did it again, boss . . . and with NATIONAL Seamless, of course!"



LIKE any capable superintendent, he's giving part of the credit to the drill pipe, casing, and tubing for bringing in a deep well in record time. And, it is deserved credit, for no driller, toolpusher, or crew can do an outstanding job without outstanding equipment.

That's why NATIONAL Seamless Drill Pipe, Casing, and Tubing are usually in the news when outstanding jobs are reported.

Made by the world's largest manufacturer of steel tubular products, NATIONAL Seamless Drill Pipe, Casing, and Tubing are universally recognized as fine as money can buy. Pierced from a solid billet of steel, NATIONAL Seamless has no welds . . . no line of potential weakness . . . absolutely seamless from end to end . . . with the same uniform wall strength throughout. Furthermore, special upset joints and improved threading practice keep its mechanical features on a par with its matchless metallurgical properties.

For detailed information on NATIONAL Seamless Drill Pipe, Casing, and Tubing, write National Tube Company, Frick Building, Pittsburgh, Pennsylvania. Ask for Bulletin No. 15.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

WALLS WITHOUT WELDS

USS

NATIONAL SEAMLESS

drill pipe . . . casing . . . tubing

UNITED STATES STEEL

J. Roy Derrick, formerly field superintendent for Wise & Hawkins and Velma Petroleum Corporation at Hobbs, N. M. has joined King, Warren & Dye, Midland, Texas, independent oil operators.

Derrick will be assistant to **Phil Yeckel,** general manager and a partner in the concern. He will also be production superintendent.

J. Roy Derrick

George Vorbe has been named chief geologist for D. D. Feldman Oil and Gas. He first went to the Mid-Continent in 1924 as geologist for the Roxana Petroleum Corporation, and subsequently served with the Texas and Pacific Coal and Oil Company, and as assistant district geologist in charge of subsurface for Stanolind Oil and Gas Company.

He opened a consulting office in Midland, Texas, which he maintained until 1942, when he became professor of geology at the New Mexico School of Mines. Until he joined the Feldman organization, he was chairman of the department of geology and advisor of the department of petroleum engineering.

Frank L. Frick

Frederick C. Loomis

Frederick C. Loomis has been appointed oil purchase and exchange agent for Standard Oil Company of California. He will centralize activities previously carried on by a number of departments and will be in charge of all the company's oil purchase and exchange negotiations and agreements.

Loomis will be assisted by **Frank L. Frick,** who has been with Standard since 1921 and has been associated with the company's crude oil purchasing operations since 1931.

Loomis was graduated from Stanford University in 1923 and his service with Standard dates to 1924. He was in the Natural Gasoline department until 1934 when he became a specialist in the department on organization. In 1945, he was made assistant manager of the Natural Gasoline department, a position he held until his present appointment.

Bishop Craddock, Sundown, Texas, has been advanced from field superintendent of the Slaughter to Mid-Continent division field superintendent by Honolulu Oil Corporation.

Craddock went to work for Honolulu 12 years ago as switcher in the Slaughter field. Previously, he had been with The Ohio Oil Company, Humble Oil & Refining Company, various independent contractors, and had operated his own casing, rig building and construction crews.

Bishop Craddock

C. W. Keith and **J. R. Fredenberger** have been elected comptroller and treasurer, respectively, of Stanolind Pipe Line Company. Keith succeeds the late **F. A. Mathis. R. E. Hruska,** an administrative assistant to the director in charge of traffic, was promoted to manager of the Procedure department and also named an assistant secretary of the company. **Donald C. Thomas,** was made assistant manager of the Procedure department and **E. F. Udeen** was named an administrative assistant to **R. J. Andress,** director in charge of traffic.

Wilford L. Cline has resigned as district geologist and general manager for The Carter Oil Company at Wichita, Kansas, and has opened an office in Wichita as a consulting geologist.

UNIT SHOWN A-50

ALTEN PUMPING UNITS

Better than ever

Long-time users tell us the NEW Alten Units are even better than the highly-regarded early models. That's no surprise to us. We've added many design and construction improvements—but only after field testing proved their worth. Try them for yourself.

Also Casing Heads, Stuffing Boxes, Stop Cocks and other production items.

A-50 FEATURES

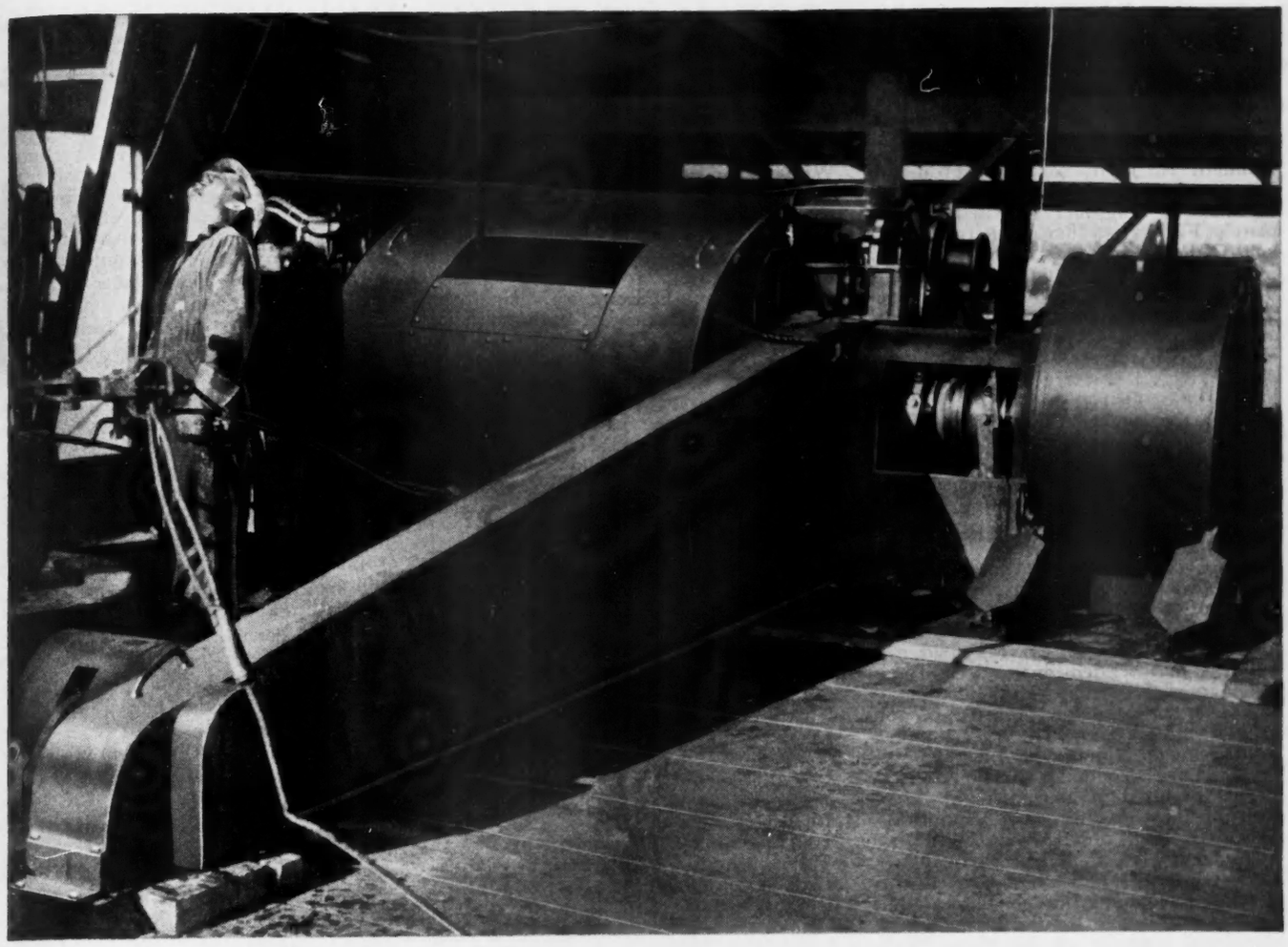
★Rigid, all-welded steel Samson Post, Frame and Beam. Structural rating: 5,100 lbs.

★Quality Gear Reducer. Hardened alloy gears and pinions. Roller-bearing equipped. Double reduction ratio: 28.4:1. Torque rating 24,750 in. lbs.

★Adjustable stroke length: 18" to 30".

★Wrist Pin and Equalizer has double-row, spherical, self-aligning roller bearings.

ALTENS
FOUNDRY & MACHINE WORKS, INC.
Lancaster, Ohio
Established 1889
Ask for Name of Nearest Dealer



For Precision Control of Heaviest Strings

The Dynamatic Drawworks Brake provides accurate finger-tip control at driller's position of heaviest strings of pipe or casing. Completely magnetic. No brake blocks or bands. No friction; nothing to wear out.

- Simple as a light circuit.
- High torque at low speeds.
- Operates on ordinary light plant current.
- Proven in all major fields, including off-shore drilling.
- Readily applied to all rigs—large or small. Can be installed in the field.

Dynamatic Drawworks Brakes are available from drawworks manufacturers and their distributors. Write for illustrated literature.

DYNAMATIC

ELECTRO-MAGNETIC

DRAWWORKS BRAKES

Sales and Service Representatives

GRIBBIN & BAYLOR

Los Angeles, Cal.
Houston and Odessa, Texas
Jennings, La.

EATON

DYNAMATIC DIVISION KENOSHA, WISCONSIN

EATON MANUFACTURING COMPANY, CLEVELAND, OHIO

Transfers and Promotions:

Kenneth R. Joynt has been promoted from assistant foreman to production foreman in Magnolia Petroleum Company's Falfurrias, Texas, district. **Garland C. Rutherford** has been transferred from the Petroleum Engineering department at Falfurrias to the Producing department as assistant production foreman. **Harold Brewer,** production foreman in the Freer area of the Alice, Texas, district, was transferred to the Brownfield, Texas, district as production foreman in the Scurry County area. **B. J. Sasser,** production foreman at Salem, Ill., moved to Luling, Texas, as production foreman. **John E. Shannon** was named assistant superintendent of the Natural Gas department's Lake Charles and Louisiana-Gulf districts, with headquarters at Lake Charles, La. **Lee E. Robinson, Jr.,** was promoted to assistant superintendent of Magnolia's Seeligson Natural Gas district, with headquarters in Premont, Texas. **Harve H. Mayfield,** assistant superintendent of the West Texas Producing division at Midland, Texas, was formerly division petroleum engineer. **Fred S. Wright, Jr.,** was promoted to division petroleum engineer of the West Texas Producing division from a special assignment as chairman of the Salem field engineering committee. **Gerald L. Smith** moved from the general offices in Dallas to Falfurrias as petroleum engineer. **James A. Graves** was promoted from district petroleum engineer at Falfurrias to assistant division petroleum engineer of the West Texas Producing division at Midland. **Henry K. Holland, Jr.,** formerly district petroleum engineer at Electra, Texas, has been promoted to assistant division petroleum engineer of the Gulf Coast division with headquarters at Houston. **William H. Bowie,** formerly petroleum engineer of the Salem district, has been promoted to district petroleum engineer at Electra. **Robert H. Lewis** has been promoted from petroleum engineer of the Falfurrias district to district petroleum engineer. **Frank E. Long,** formerly of the Producing department at Falfurrias, has been transferred to the Petroleum Engineering department at Salem. **Charles F. Girand** has been made petroleum engineer in Magnolia's general offices in Dallas, as a member of the Reserves and Evaluation section of the Petroleum Engineering department. **James G. Litherland, Jr.,** formerly petroleum engineer in the Louisiana-Gulf division offices at Morgan City, La., has been transferred to the Falfurrias district.

S. E. Wallette, Humble Oil & Refining Company district superintendent at Hub, Louisiana division, was transferred to the Sunniland district, replacing **R. B. Gustafson.** Gustafson was transferred to the Eucutta district as district superintendent. **C. K. Seaman,** assistant district superintendent at Sunniland, has been transferred to the Wink district in the West Texas division. **Robert L. Mills,** assistant district superintendent at Galveston Bay, was transferred to the Petroleum Engineering division in the Houston office for work as supervising engineer. **Paul L. McGee,** assistant district superintendent of the London district, was transferred to Goose Creek, Texas, as district petroleum engineer. Assistant District Chief Clerk **J. F. Richie** was transferred from the Eucutta district to the Houston Gas Construction division. **James W. Roark,** assistant district chief clerk of the North Katy district, was transferred to the Marine Equipment division in the Houston office. **John C. McDuffie,** former associate petroleum engineer, was transferred from the East Texas division office to the Petroleum Engineering division in Houston for work as petroleum engineer. **M. M. Porter** has been placed in charge of the Houston warehouse as district chief clerk, replacing **J. N. Smith.** Smith was transferred to the Material Distribution section, Houston office.

John B. Rosen has been named district engineer in the Lubbock, Texas, district, and **George L. Ellis** has been promoted from geologist to senior geologist at the Fort Worth division, Stanolind Oil and Gas Company. Ellis will direct geophysical and geological coordination and replaces **F. H. Schouten** who has been transferred to the company's Canadian division . . . **C. R. Merrill,** material department, The Pure Oil Company, has been transferred from Pauls Valley, Okla., to Billings, Mont. . . . **D. M. Rounds,** The Texas Company, has been transferred from Salem, Ill., to Wichita, Kansas, and has been succeeded by **Paul Youngmeyer** . . . **Aubrey Weatherholt,** Empire Pipeline Company, has been named district superintendent in the Oil Hill, Kansas, area, succeeding **C. A. Mason,** retired; **T. J. Lanagan** has been transferred from Cushing, Okla., to Odessa, Texas, as district superintendent. **W. L. Kline** has been promoted from assistant superintendent to superintendent of the Cushing district. **O. V. Adkins** has been named district superintendent of operations in North Texas . . . **Robert W. Pitcher,** formerly of Tulsa, has been named manager of the Crude Oil department of Pan American Production Company with headquarters in Houston . . . **W. O. Twaits,** formerly manager of Coordination and Economics department of Imperial Oil, Ltd., in Toronto, has been transferred to the Producing department, Western division, Calgary, as management assistant.

EACH WAY-EVERY DAY

—DAILY Flights to—

VENEZUELA and JAMAICA!

Chicago & Southern Air Lines' fleet of 4-motored Douglas Skymasters now offers seven-days-a-week service through the Houston and New Orleans gateways to Caracas and Kingston. Flights each way every day provide one-plane service from the Great Lakes to the Venezuelan oil capital. Ask your travel agent or nearest C&S ticket office.

CHICAGO & SOUTHERN AIR LINES

General Offices, Memphis, Tenn., U.S.A.

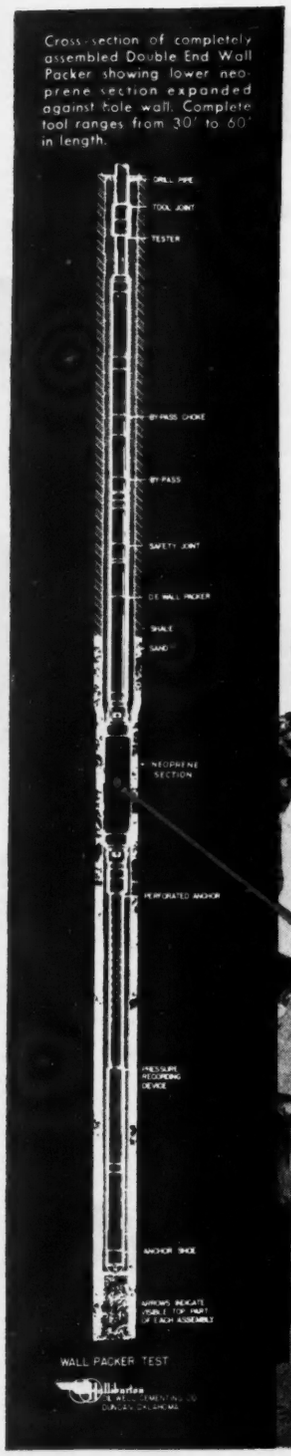
C★S

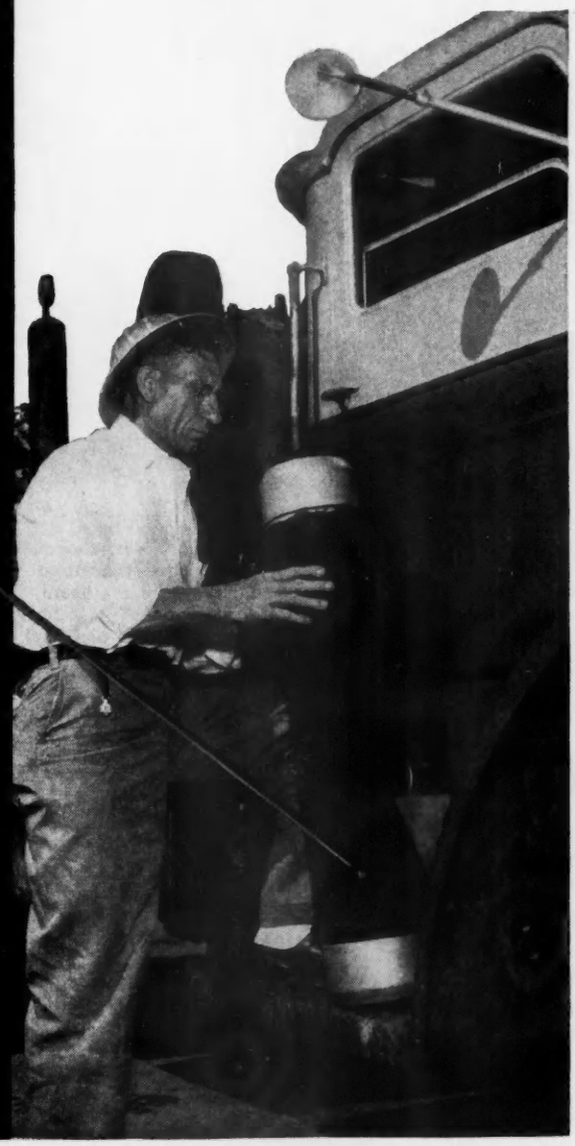
D. A. Shock, formerly on the research staff of the University of Texas, Austin, has been appointed senior research chemist in charge of the production chemistry in Contintental Oil Company's production laboratory. Shock is a chemical engineering graduate from Colorado College, Colorado Springs, Colo., and obtained his masters degree in chemistry from the University of Texas. Before his work at the University of Texas he had been employed by International Minerals and Chemicals Corporation, Austin, and Dow Chemical Company, Midland, Mich.

D. A. Shock

"IN FORMATION TESTING—EVERYTHING DEPENDS ON OUR NEOPRENE PACKER,"

Says Halliburton Oil Well Cementing Co.





Neoprene section of Double End Wall Packer before assembly into complete tool. Section compresses as much as 11" and expands as much as 3½" in hole.

Here's another instance where engineers specified neoprene for a tough job . . . a job requiring a flexible material with exceptional properties. They chose neoprene for the most vital part of the Howco Double End Wall Packer.

This tool must seal off *tightly* hole sections to be tested . . . must prevent drilling mud from leaking into the fluid area. It often must operate under several tons of hydrostatic pressure and temperatures up to 350°F. Neoprene withstands these destructive influences and also resists the deteriorating effects of oil, gas, chemicals and acids to which it is constantly exposed. The neoprene packer is flexible enough to expand and seal off every ragged fissure in the hole wall . . . yet strong enough to flex back to normal shape when the drill string is lifted. Neoprene does this difficult job efficiently, time and time again, without a failure.

If your equipment requires rubber in any form, ask your nearest rubber manufacturer or write direct for full information on Du Pont neoprene. It can be compounded with just the right balance of properties for your needs.

E. I. du Pont de Nemours & Co. (Inc.)
Rubber Chemicals Division K-10
Wilmington 98, Delaware

FREE! The Neoprene Notebook. *Interesting stories . . . new, unusual applications of neoprene. Write . . . E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division K-10, Wilmington 98, Delaware*

HERE'S WHY NEOPRENE DOES SO MANY JOBS SO WELL!

- ★ High tensile strength, resilience, low permanent distortion.
- ★ Tough and durable, resists abrasion and cutting.
- ★ Superior resistance to sunlight, aging, ozone, and heat.
- ★ Resistance to deterioration by oils, solvents, chemicals, acids.
- ★ Superior air-retention, low permeability to gases and fluids.
- ★ Special compositions are flame-retarding, static-conducting, flexible at low temperatures.

FOR BETTER EQUIPMENT, SPECIFY

NEOPRENE

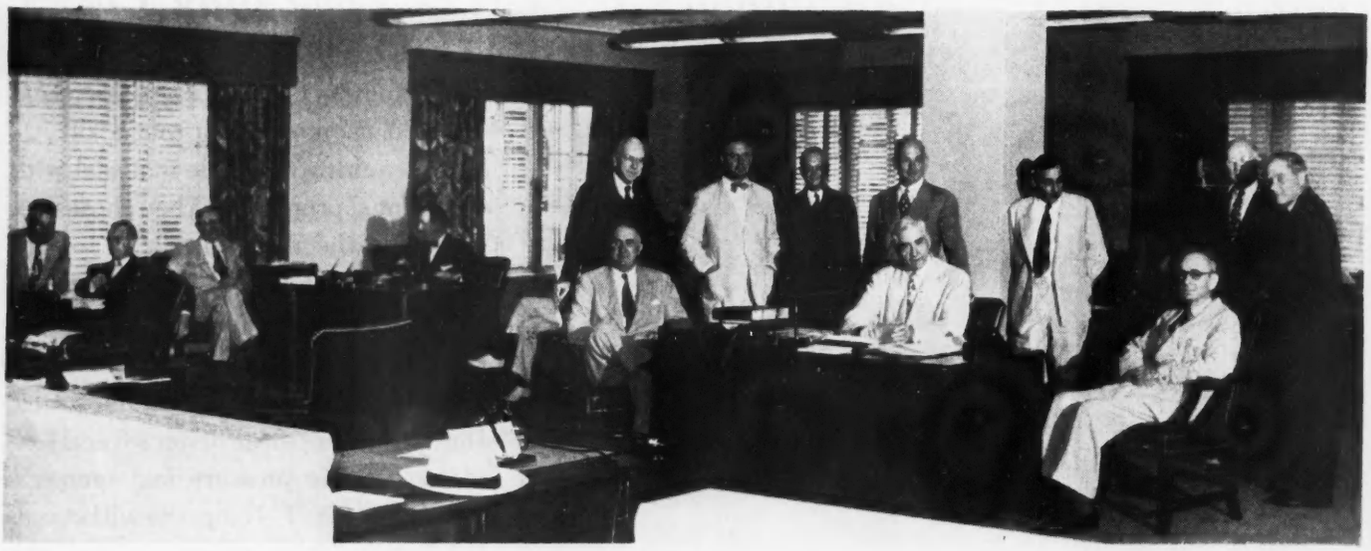
The rubber made by Du Pont

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

EQUIPMENT AND SERVICE SUPPLIERS' NOTES



NEW BANK OFFICES—Facilities of The National Bank of Commerce, Houston, on the mezzanine floor in the new 12-story addition to the Gulf Building were inspected by officers and directors of the bank. These offices are connected with the main lobby by escalator as well as elevator service. Seated, left to right, are Gainer B. Jones, E. O. Buck, B. Magruder Wingfield and P. C. Rehrauer, vice presidents; J. S. Leach, director; Jesse Jones, chairman of the board, and Sam Taub, chairman of the executive committee. Standing, left to right, are A. D. Simpson, vice chairman of the board; George A. Butler, director; R. P. Doherty, president, and M. Tilford Jones, Frank A. Liddell, C. B. Japhet, Fred J. Heyne and Paul Kayser, directors.

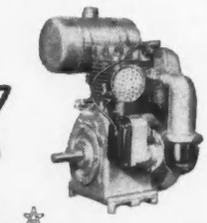
AN ALL TIME RECORD FOR AN ALL STAR TEAM!

40.2% of All Carburetor Type Engines Built in 1947, 2 to 30 hp. Were WISCONSIN Heavy-Duty Air-Cooled ENGINES!

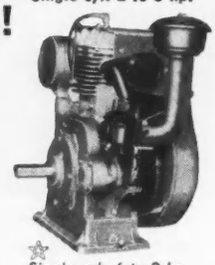
And here's the ALL STAR lineup . . . released in an official bulletin of the Bureau of Census, U. S. Dept., of Commerce, April 22, 1949.

In 1947, Wisconsin Motors built 51.7% of the engines in the 2 to 5 hp. range . . . in the 5 to 9 hp. range, 36.4% . . . 71.6% in the 15 to 22 hp. range . . . and in the 25 to 40 hp. range, 14.7%. Averaged together, 40.2% of the engines in the 2 to 30 hp. range were Wisconsins — excluding automotive, aircraft and outboard marine engines, and engines for use as original equipment by various manufacturers.

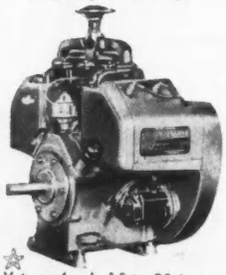
These figures sum up the confidence of equipment builders and users who are the final judges in choosing superior engines *where it counts most* . . . on the job delivering the goods.



Single cyl. 2 to 6 hp.



Single cyl. 6 to 9 hp.



V-type 4-cyl. 15 to 30 hp.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.

Seismograph Service Elects Hugh Thralls Vice President

Seismograph Service Corporation has elected Hugh M. Thralls, Tulsa, vice president of the organization. Thralls has been a director and chief geophysicist of the company.

Hugh M. Thralls

Graduated in 1934 from the University of Oklahoma with an M. S. degree in physics, he joined SSC in 1936 as party chief of a crew in Illinois. He served also in Oklahoma, Michigan, Texas and California. He was made supervisor in 1939 and in 1945 was named chief geophysicist.

The corporation also announced the resignations of T. A. Manhart and George W. Reed as directors.

L. G. Cornish, an employe for 18 years, has been placed in charge of the company's Midland, Texas, office.

Franklin Vice President Transfers

Stanley Martin, vice president of Franklin Supply Company, Chicago, has transferred to Mt. Pleasant, Mich., to handle company operations in Michigan and Ohio. Kenneth Goodell has been appointed district manager and transferred to East Chicago, Ind. Roy Wood, vice president, is now in Chicago.

breaking drilling records in soft formations—

Expressly designed for use in the softer formations — such as compact sand, shale, chalk, red bed, salt, etc., commonly found in oil fields — the CP Type ES Three Cone Rock Bit is breaking drilling records for feet per hour.

Built for maximum resistance to hard, abrasive wear, these bits give the long service demanded by modern drilling methods. Cones and bearing journals are of high alloy forged steel, accurately machined and carefully heat-treated, with a special hard facing on the teeth of the cones.

CP bits are designed in the necessary types and sizes to meet the specific drilling requirements in different oil fields. Prompt service is assured in the Mid-Continent and Rocky Mountain fields.

CHICAGO PNEUMATIC TOOL COMPANY

MANUFACTURED AT FRANKLIN, PA.

GENERAL & EXPORT OFFICES: 6 EAST 44th STREET, NEW YORK 17, N. Y.

Oil Tool Sales Office: One N. W. 16th Street, Oklahoma City, Oklahoma

NATIONWIDE SERVICE
for Santa Fe Shippers

★ Indicates Santa Fe Traffic Office
—Indicates principal Santa Fe Rail Lines

Santa Fe Traffic Offices are conveniently located to serve freight shippers in all parts of the nation

Wherever you are located in the United States, Canada or Mexico, there is a Santa Fe freight representative assigned to your locality and at your service.

Each traffic office has direct communication by telephone or teletype with other Santa Fe offices, and are fully equipped to give you promptly the information and service you want.

Santa Fe freight men know their business. They know your territory and ours—and your local freight problems, too. Because these men believe in giving service, you will find it worth while to call them about your freight shipments.

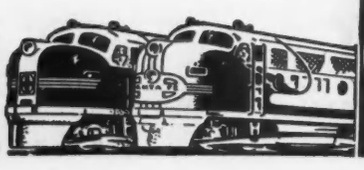
Look over this listing of traffic offices and call the one nearest you for friendly, helpful Santa Fe service.

SHIP via
Santa Fe all the way

F. H. Rockwell, Gen. Freight Traffic Manager

Santa Fe Traffic Office Centers

Albuquerque, N. M.
Amarillo, Tex.
Atchison, Kan.
Atlanta, Ga.
Bakersfield, Cal.
Beaumont, Tex.
Boston, Mass.
Buffalo, N. Y.
Chanute, Kan.
Chicago, Ill.
Cincinnati, O.
Cleveland, O.
Colorado Springs, Colo.
Dallas, Tex.
Denver, Colo.
Des Moines, Ia.
Detroit, Mich.
El Paso, Tex.
Flagstaff, Ariz.
Fort Madison, Ia.
Fort Worth, Tex.
Fresno, Cal.
Galveston, Tex.
Houston, Tex.
Hutchinson, Kan.
Indianapolis, Ind.
Kansas City, Mo.
Leavenworth, Kan.
Long Beach, Cal.
Los Angeles, Cal.
Lubbock, Tex.
Mexico City, Mex.
Milwaukee, Wis.
Minneapolis, Minn.
Monterrey, Mex.
New Orleans, La.
New York City, N. Y.
Oakland, Cal.
Oklahoma City, Okla.
Peoria, Ill.
Philadelphia, Pa.
Phoenix, Ariz.
Pittsburgh, Pa.
Portland, Ore.
Pueblo, Colo.
St. Joseph, Mo.
St. Louis, Mo.
Sacramento, Cal.
Salt Lake City, Utah
San Angelo, Tex.
San Antonio, Tex.
San Bernardino, Cal.
San Diego, Cal.
San Francisco, Cal.
San Jose, Cal.
Santa Barbara, Cal.
Santa Rosa, Cal.
Seattle, Wash.
Stockton, Cal.
Temple, Tex.
Topeka, Kans.
Tulsa, Okla.
Washington, D. C.
Wichita, Kans.
Wichita Falls, Tex.



Santa Fe

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Core Lab West Texas Operations Will be Directed from Midland

Core Laboratories, Inc., Dallas, announced the removal of West Texas district administrative offices from Dallas to the Wemple - Aveny Building, Midland, Texas.

Rufe S. Bynum

Rufe S. Bynum, district engineer, will direct the company's services from the new quarters. Permanent laboratory facilities, also located at Midland, will remain at their present site.

J. D. Isaacks Is Selected as Kerotest General Sales Manager

J. D. (Eb) Isaacks, well known to the oil industry throughout the world, has been made general manager of sales for the Kerotest Manufacturing Company of Pittsburgh. Prior to his being made sales manager, Isaacks was in charge of production for Kerotest, and prior to that he was in the Sales department, stationed in Houston and Los Angeles. He has made several trips to South America for the company.

Price Establishes Permanent Coating Plant at New Orleans

A complete Somastic coating plant has been installed south of New Orleans on the Intra-Coastal Canal, by H. C. Price Company. This permanent plant will afford Somastic pipe coating facilities for corrosion protection throughout the Gulf States Area for all pipe sizes up to and including 30 inches in diameter. The yard has ample space for stockpiling bare and coated pipe and is conveniently located for rail and marine transportation.

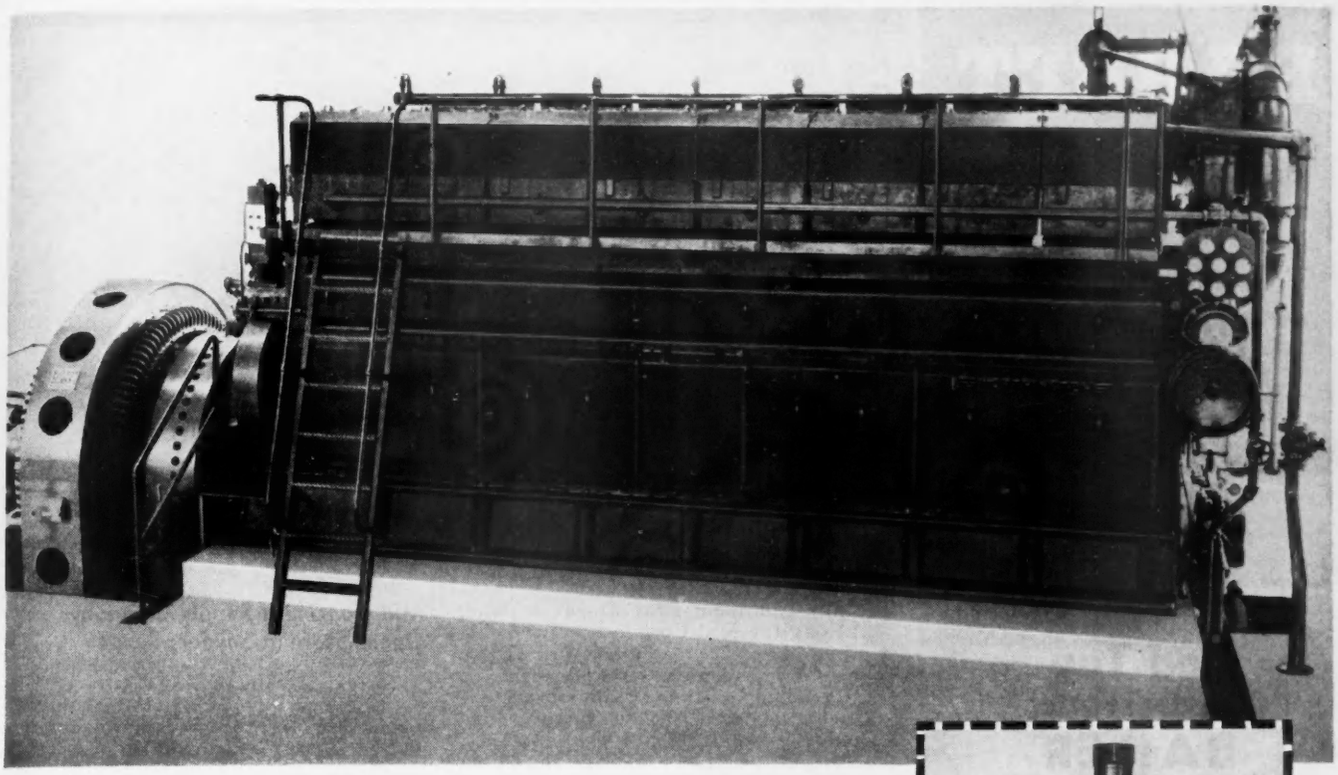
Robert P. White

Equipment will be installed to manufacture and apply concrete over Somastic coating for weight and additional protection to the pipe in marine and swamp installations. Pipe will be cleaned by the steel grit shot-blasting method.

Robert P. (Bob) White has been appointed Gulf division manager in charge of sales and coordination of Somastic operations with headquarters at New Orleans.

White has been associated with Somastic coating operations since 1940. After graduating from the University of Cincinnati, he started work at Archer City, Texas, as materials checker, and acted in the capacity of inspector, engineer, office manager, and superintendent, until he entered service in World War II in March, 1943, as an ensign in the Navy.

Another reason for the superiority of Worthington Dual Fuel Engines . . .



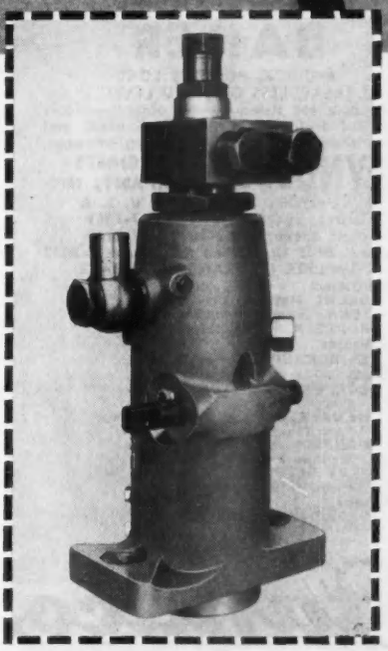
THE DUAL PLUNGER FUEL PUMP

. . . a recent Worthington Development

One pump with two tandem-mounted plungers handles full load of engine on oil operation as well as small pilot oil requirements on gas operation.

THE RESULT? NINE ADVANTAGES THAT ADD UP TO GREATER DUAL FUEL ENGINE EFFICIENCY

1. The time-proved merit of individual fuel pumps and equal-length discharge pipes to each power cylinder
2. Single oil fuel injection nozzle for both gas and oil fuel operation
3. Instantaneous, smooth conversion from one fuel to the other
4. Pilot oil injection control independent of main injection
5. Reduced firing pressures
6. Lower exhaust temperatures
7. Quieter operation
8. Better combustion characteristics
9. Lower fuel consumption



For further proof that in Dual Fuel Engines, as in so much other equipment, *there's more worth in Worthington*, write for Bulletin S-500-B45. *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

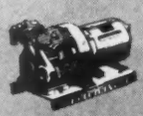
WORTHINGTON

E9-3

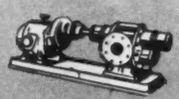
YOUR PARTNER IN POWER PROGRESS

Diesel engines, 150 to 2,640 hp . . . gas engines, 175 to 1,720 hp . . . dual fuel engines, 225 to 2,640 hp.

WORTHINGTON-BUILT AUXILIARIES

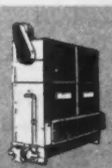


Balanced Angle Compressors



Oil Transfer Pumps

Cooling Water Circulating Pumps



Evaporative Type Engine Water Cooler

BARRET

SPECIALIZING IN MAGNETIC SURVEYS

Contracts accepted for domestic and foreign projects, using the most improved instrumental and interpretative technique.

William M. Barret, Inc.

Consulting Geophysicists

GIDDENS-LANE BUILDING
SHREVEPORT, LOUISIANA

Red Top (Hydrostatic) BAILER

A QUICK, POSITIVE LOAD REGARDLESS OF FLUID LEVEL.
Ideal also for fishing small objects—widely used for drilling in (completing) wells, and for drilling cement or plastic plug overages.

REYNOLDS SPECIALTY COMPANY, INC.
SHREVEPORT, LOUISIANA, U. S. A
Office: 804 Erie St., Phone 7-7511
If no answer call 2-2023 or 7-2149
Factory: 2202 Greenwood Rd., Phone 2-2023
COMPLETE INSURANCE COVERAGE

Louisiana:
DELHI, Hayes Lumber Co.
JENA, Germany Machine Co.
RODESSA, Republic Supply Co.
Arkansas:
EL DORADO, Cox Supply Co.
Texas:
CORPUS CHRISTI, A. S. Baylor, Phone 2-2461
HENDERSON, J. C. Phillippi, Mgr. East Texas Div., Phone 9716-J1
HOUSTON, W. A. Swink, Phone Wydown 9-2858
SERVICE, Phone 3, Turnertown, or Phone 1010, Greggton
Kansas:
GREAT BEND, Moss Scranton, Phone 312

Standco NO-SMOKE

STANDCO BRAKE LINING

Is the driller's best friend because it makes the easiest brake known and "feeds off evenly while drilling." It never scores brake rims. See pages 3608-3613, Composite Catalog.

Standco Brake Lining Co.
HOUSTON

HOUSTON LABORATORIES
Analytical and Consulting Chemists
Podbielniak Gas Analyses, Oil Field Brines, Waters, Cores, Muds, etc. Reservoir equilibria studies for crude and condensate wells.
LD 267—Box 132 Houston, Texas

EQUIPMENT and SERVICE SUPPLIERS' NOTES

New Field Store Opened in Kansas

A new field store of Mid-Continent Supply Company has been opened at Plainville, Kansas. C. C. Harris, formerly of the company's Great Bend store, is manager of the store. Field salesman for the area served by the store is E. G. Mog, who also has been at Great Bend. Other Plainville personnel are L. O. Hedrick, Jr., formerly with Bethlehem Supply Company; R. C. Van Leeuwen of Pittsburgh, Kansas, and B. G. Remmert, from the Mid-Continent store at Great Bend.

Among the Mid-Continent officials attending the store opening were D. H. Thornbury, executive vice president; J. E. Everroad, machinery and diesel department manager; R. O. Moore, merchandising manager; and Victor LeMay, advertising director, all of the Fort Worth office. S. R. Clinkscales, Tulsa division manager, and Nick Carter, Wichita, Kansas, district manager, also attended.

Lane-Wells Sets Depth Records for Perforating, Radioactivity Logging

In The Superior Oil Company's Pacific Creek 1, world's deepest well, Lane-Wells Company radioactivity well logging and Koneshot perforating services were successfully performed at the greatest depth in which either of these services had been used. Standard equipment was used in both operations.

A combination radioactivity well log (gamma ray and neutron survey) was run to a total depth of 19,743 feet. The area logged extended from 19,741 to 9500 feet.

The well was gun perforated by the Koneshot process with 168 charges being fired below 13,000 feet on July 2. Charges were fired again at 14,000 and 15,600 feet, and on July 14, 200 charges were fired below 17,400 feet.

Mid-Continent Supply Company Opens Store at Snyder, Texas

Formal opening of Mid-Continent Supply Company's new field store at Snyder, Texas, was observed with an open house and barbecue for about 1800 guests. Mid-Continent officials from Fort Worth who attended the celebration were Ken W. David, president and general manager; Kenneth David, Jr.,; R. O. Moore, merchandising manager; Harold Powell, manager of the Tubular department; M. L. Harwell, sales engineer; and Victor LeMay, advertising director.

D. C. McIver, formerly at the Eunice, N. M., store, is Snyder store manager. Other personnel includes R. E. Dunn, field salesman, formerly at Eunice; T. R. Freeman, field salesman, formerly at Hobbs, N. M.; C. L. Washburn, Eunice; W. B. Nance, Sundown, Texas; E. M. Wilson and M. H. Ross, Odessa, Texas; and W. W. Taylor, Jr., Fort Worth.

Johnston Forms Canadian Company

M. O. Johnston has formed the M. O. Johnston Oil Field Service, Ltd., with headquarters at Edmonton, Alberta, to serve the needs of Canadian operators. Joe Barlow has been appointed manager. The establishment makes a total of 35 Johnston service locations.

Skeet Shooters, Hunters!

Here's a beautiful lifetime cabinet for storing your guns and equipment (see photo at left). Made by real craftsmen, hand-rubbed finish.

Dimensions: 74" high, 46" wide, 15" deep. Gun cabinet 48¼" inside height. Cabinet base has 3 drawers, 2 lockers. Gun case and 1 locker equipped with cabinet locks. All hardware black forged iron, all glass ⅛" plate. Built in two pieces for ease of shipment. Specify whether desired for 8 or 12 guns.

NORTHERN BLACK WALNUT, $200 fob factory
WESTERN KNOTTY PINE, $175 fob factory

(We pay shipping charges west of Mississippi and east of Rockies south of Kansas City.)

MODERN MODE FURNITURE MFG. CORP.
Dept. B—124 W. Jones—San Antonio, Tex.

Imagine TWO Hydraulic Gates—13⅝" bore

*in only 30" total cellar height!**

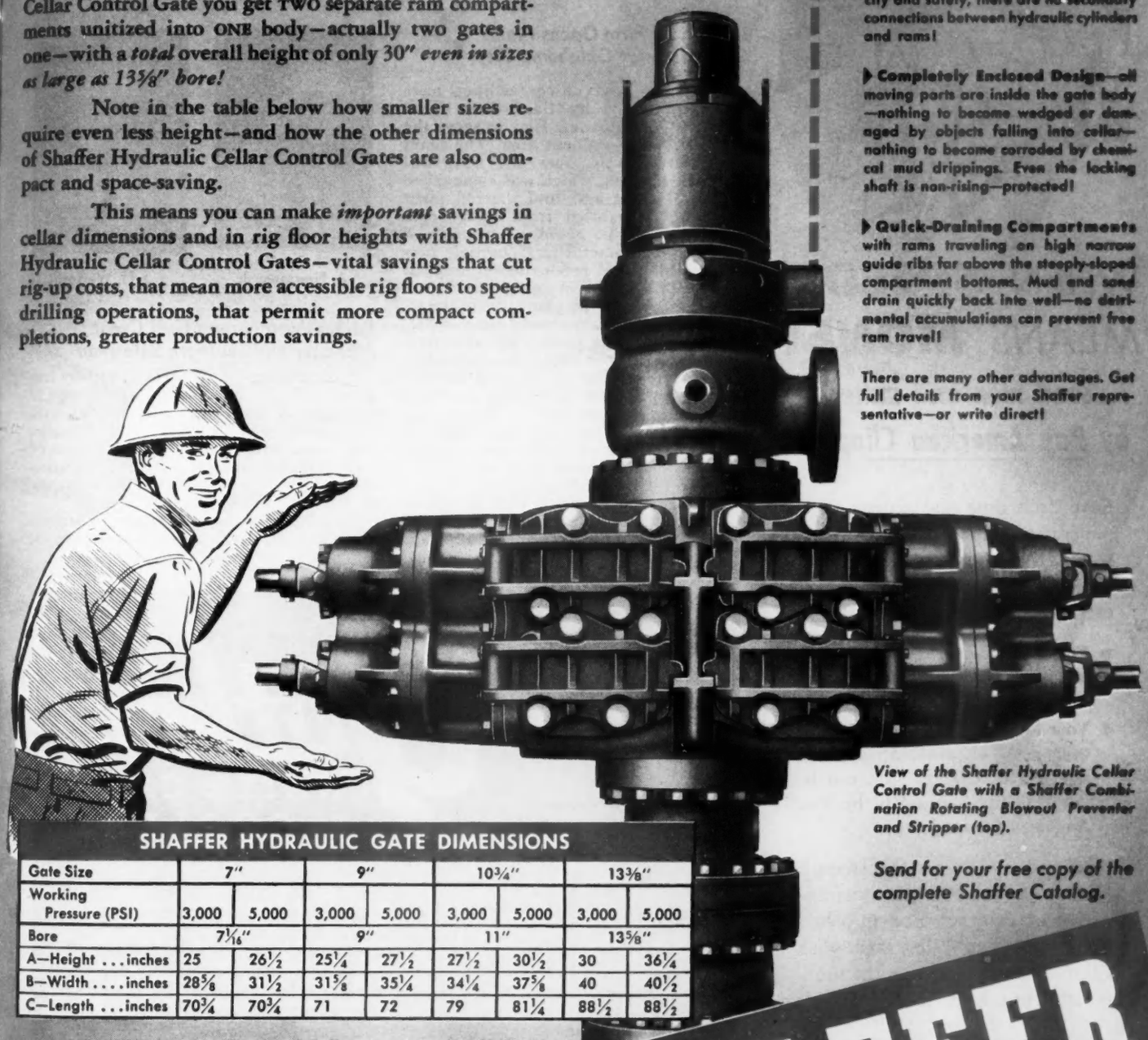
that's what you get in the NEW

SHAFFER Hydraulic CELLAR CONTROL GATE!

That's right—in the new Shaffer Hydraulic Cellar Control Gate you get TWO separate ram compartments unitized into ONE body—actually two gates in one—with a *total* overall height of only 30" *even in sizes as large as 13⅝" bore!*

Note in the table below how smaller sizes require even less height—and how the other dimensions of Shaffer Hydraulic Cellar Control Gates are also compact and space-saving.

This means you can make *important* savings in cellar dimensions and in rig floor heights with Shaffer Hydraulic Cellar Control Gates—vital savings that cut rig-up costs, that mean more accessible rig floors to speed drilling operations, that permit more compact completions, greater production savings.



View of the Shaffer Hydraulic Cellar Control Gate with a Shaffer Combination Rotating Blowout Preventer and Stripper (top).

SHAFFER HYDRAULIC GATE DIMENSIONS

Gate Size	7"		9"		10¾"		13⅜"	
Working Pressure (PSI)	3,000	5,000	3,000	5,000	3,000	5,000	3,000	5,000
Bore	7 1/16"		9"		11"		13⅝"	
A—Height . . . inches	25	26½	25¼	27½	27½	30½	30	36¼
B—Width . . . . inches	28⅝	31½	31⅝	35¼	34¼	37⅝	40	40½
C—Length . . . inches	70¾	70¾	71	72	79	81¼	88½	88½

**Smaller sizes even less height!*

And space-saving compactness—important as it is—is only one of *many* far-reaching advancements incorporated into the new Shaffer Hydraulic Cellar Control Gates. Some of the others are outlined at right, but space does not permit telling the *complete* story on this great new cellar control gate. So before you buy *any* control gate equipment, be sure to get ALL the facts about the new Shaffer Hydraulic Cellar Control Gate. It's the outstanding buy in the field!

These and Other Unique Features Are Yours In The New SHAFFER HYDRAULIC CELLAR CONTROL GATE!

▶ **Simple Ram Changes**—the simplest in *any* gate. Merely unbolt and swing open a side door, slide out the ram assembly, slide in the new assembly, close and bolt the door. It's that simple—*and complete ram changes can be made whether pipe is in or out of the well!*

▶ **Direct Hydraulic Drive** with the hydraulic operating cylinders *directly behind* the rams. For maximum simplicity and safety, there are no secondary connections between hydraulic cylinders and rams!

▶ **Completely Enclosed Design**—all moving parts are inside the gate body—nothing to become wedged or damaged by objects falling into cellar—nothing to become corroded by chemical mud drippings. Even the locking shaft is non-rising—protected!

▶ **Quick-Draining Compartments** with rams traveling on high narrow guide ribs far above the steeply-sloped compartment bottoms. Mud and sand drain quickly back into well—no detrimental accumulations can prevent free ram travel!

There are many other advantages. Get full details from your Shaffer representative—or write direct!

Send for your free copy of the complete Shaffer Catalog.

SHAFFER

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

SHAFFER TOOL WORKS, Brea, California • California Service Shops: Santa Fe Springs and Taft
HOUSTON, TEXAS, 6006 Navigation Blvd. • ODESSA, TEXAS, 1925 West Second Street
OKLAHOMA CITY, OKLAHOMA, Acme Oil Tool Company, 1001 S. E. 29th Street
EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

26 YEARS OF OIL TOOL LEADERSHIP

WHEN **SPEED** MEANS **MONEY**

...send men and materials by Pan American Clipper*

Save both time and money. Pan American Clippers are at your service to fly both men and equipment to oil fields on any of the earth's six continents.

- **Your key personnel can reach drilling or refining sites much faster by Clipper.**
- **Your essential drilling and refining equipment . . . shipments of every size and description . . . can be flown swiftly and safely by Pan American Clipper Cargo.**

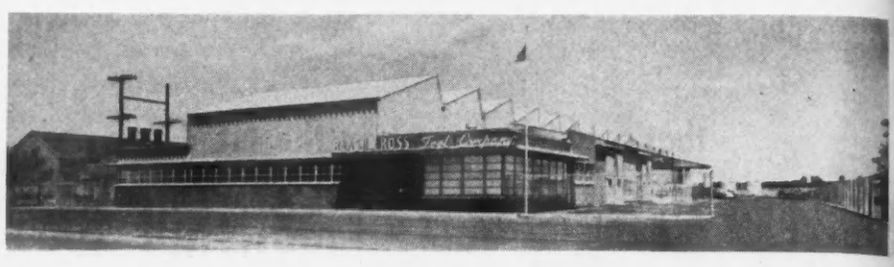
You can *depend* on the smooth efficiency of the World's Most Experienced Airline! For information, fares and rates, call your Clipper Cargo Agent or the nearest Pan American office.

*Trade Mark, Pan American Airways, Inc.

PAN AMERICAN WORLD AIRWAYS

PAA

EQUIPMENT and SERVICE SUPPLIERS' NOTES



NEW BAASH-ROSS PLANT—Baash-Ross Tool Company's new plant and office facilities in Oklahoma City.

Baash-Ross Firm Opens Plant And Offices at Oklahoma City

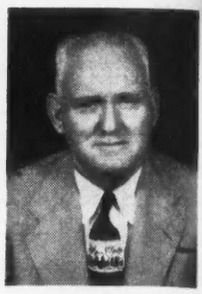
New plant and office facilities have been constructed by Baash-Ross Tool Company in Oklahoma City to serve the northern Mid-Continent area. The plant was built directly over the original Baash-Ross plant, which was established almost 20 years ago, and the old plant was then dismantled from underneath the new plant. To avoid interruption of sales and manufacturing activities, new machine tools and production equipment were installed and in operation before dismantling of the old plant was initiated.

The plant contains more than 20,000 square feet of floor space and has a main bay with a 50-foot clear span and 320-foot travel serving plant, and storage yard equipped with a five-ton overhead electric traveling crane.

Special thread milling machines and an advanced type of heat-treating equipment have been installed in addition to customary shop facilities.

The Baash-Ross plant will serve also as warehouse and office headquarters for the Northern Mid-Continent area.

J. A. Newsome, Jr.



J. N. Wofford

Parkersburg Names Gulf Coast Manager and Southern Salesman

Parkersburg Rig & Reel Company has promoted J. N. (Babe) Wofford to manager of the Gulf Coast district with headquarters in Houston. Wofford, who has been with the company 21 years, was formerly manager of the Houston branch. He has represented the company in the Gulf Coast for 16 years.

J. A. Newsome, Jr., has joined Parkersburg as special sales representative in the

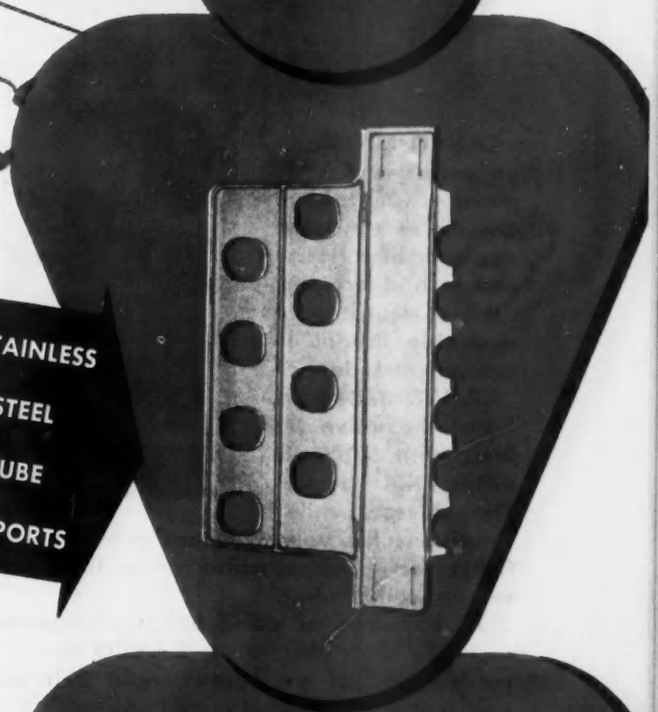
Gotkool
WATER CANS & COOLERS
Gott
WATER CAN
GOTKOOL WATER CAN
Made in 1½, 2, 3, 5, 10, 15 and 20 gallon sizes. (Push-Button Faucet at slight additional cost.)
GOTT Water Cans are the practical way to keep drinking water cool for long periods, protected from impurities and always handy to the job. Snug fitting large removable top, strongly built to withstand rough usage. GOTT Water Coolers have extra large covers and a handy non-leaking push button faucet. Your Supply Store has them, get one today! . . . . . .
GOTKOOL WATER COOLER
Made in 2, 3, 5, 8, 10, 15 and 20 gallon sizes with Push-Button Faucet.
H. P. GOTT MFG. CO.
WINFIELD, KANSAS
KEEP PURE DRINKING WATER ALWAYS HANDY

STAINLESS STEEL CASTINGS

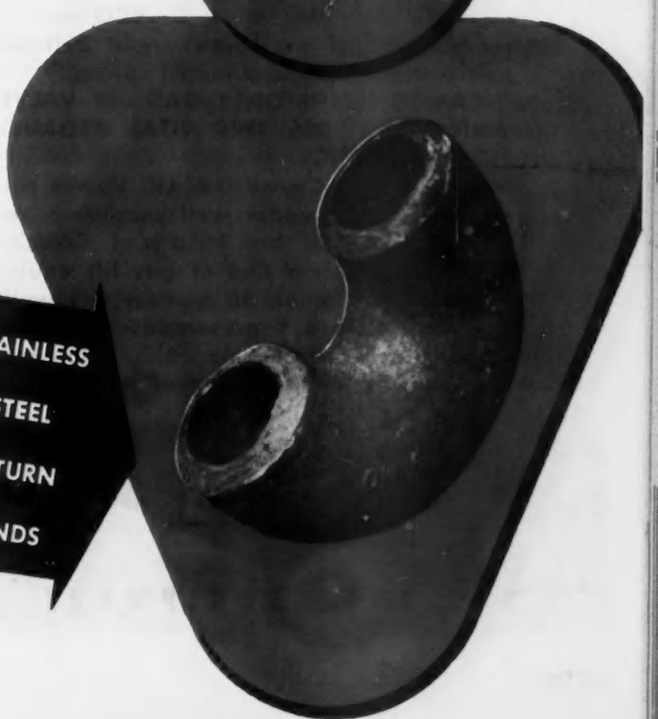
STAINLESS STEEL FURNACE BRACKETS

TESCO PROVIDES AN IMMEDIATE SUPPLY

RIGHT IN THE HEART OF THE OIL COUNTRY



STAINLESS STEEL TUBE SUPPORTS



STAINLESS STEEL RETURN BENDS

These stainless steel refinery castings are typical of the work TESCO is now doing for many manufacturers and operators in the Gulf Coast area. Stainless steel well head castings, valves, chokes and various fittings are other stainless steel pieces produced for oil equipment manufacturers by TESCO.

TESCO is qualified to produce your stainless steel castings for heat and corrosion resistant from a pound to a ton, carefully controlled through constant laboratory analysis exactly to your specifications.

TESCO is right in the middle of the industrial Gulf Coast . . . on the spot to better service the steel casting needs of this area. The TESCO representative and TESCO Metallurgists will be glad to discuss your stainless or carbon steel casting requirements with you.

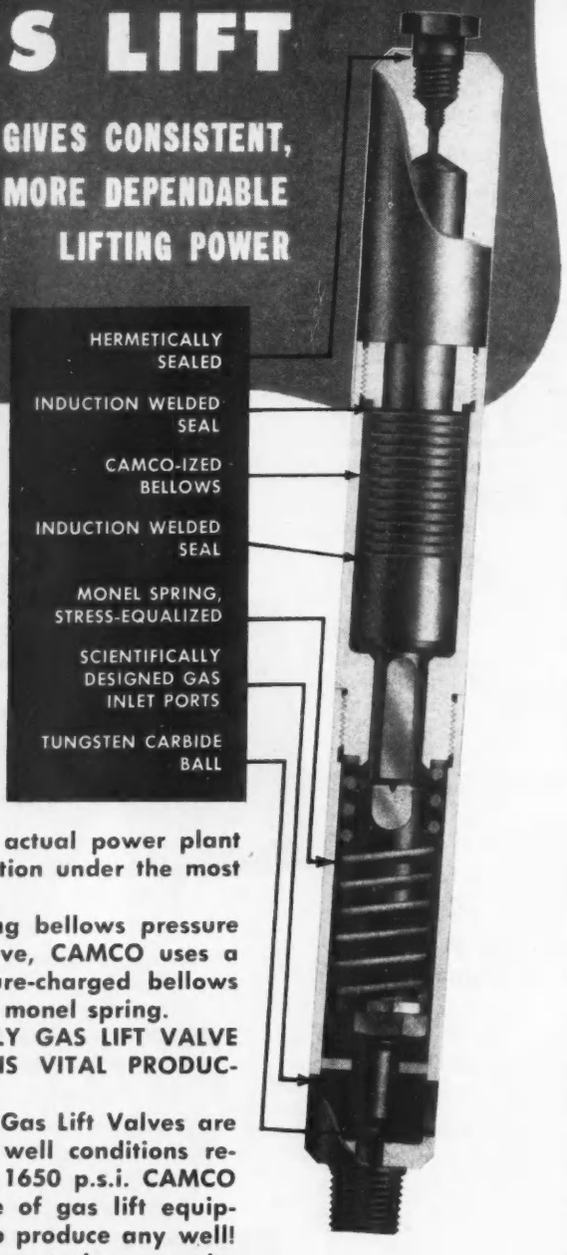
TEXAS ELECTRIC STEEL CASTING CO.

GOOD CASTINGS TESCO CARBON AND ALLOY STEEL HOUSTON, TEXAS

CAMCO

GAS LIFT

CAMCO-IZING GIVES CONSISTENT, MORE DEPENDABLE LIFTING POWER



CAMCO-IZING . . . an exclusive CAMCO process . . . is the only answer to consistent, dependable lifting power and economical gas-fluid ratios available in gas lift equipment today.

CAMCO-IZING preforms the valve bellows with 5,000 lbs. differential pressure. Thus, it tests while it conditions the valve's actual power plant for correct, positive action under the most severe well conditions.

And instead of using bellows pressure alone to close the valve, CAMCO uses a combination of pressure-charged bellows and a stress-equalized monel spring.

CAMCO IS THE ONLY GAS LIFT VALVE WHICH PROVIDES THIS VITAL PRODUCTION INSURANCE.

Hundreds of Camco Gas Lift Valves are installed today under well conditions requiring from 125 thru 1650 p.s.i. CAMCO makes a complete line of gas lift equipment . . . equipment to produce any well! Ask your Camco Representative or write Camco, Inc., 1108 Scanlan Bldg., Houston, for help with your production problems.

Your copy of the new Camco Catalog is now ready. Write for it today

CAMCO

GAS LIFT EQUIPMENT AND SERVICE

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Southern division for Hydracepters and separators. Newsome, one of the original designers and engineers of the Hydracepter, was formerly with Parks Engineering Company of Houston. For 11 years he was with the Products Research division of Humble Oil & Refining Company.

Cummins Sales & Service Chooses J. T. Calnon as Sales Manager

J. T. Calnon has been appointed sales manager of Cummins Sales & Service, Inc., with headquarters at the general offices in Ft. Worth.

J. T. Calnon

Calnon joined the company in 1945 after his release from the Navy, where he was attached to the USS *Whitney* as chief petty officer in charge of diesel maintenance and repair. He worked as district service manager at the company's Houston and Wichita Falls service points until August, 1947, when he was sent to Odessa as West Texas division service manager.

Lane-Wells Appoints Rutledge as Gulf Coast Division Sales Manager

Robert M. Rutledge, Jr., has been named Gulf Coast division sales manager for Lane-Wells Company, with headquarters in Houston. He succeeds C. F. Ludwig, who has become vice president of Lane-Wells Canadian Company.

Rutledge was formerly assistant division sales manager for the Gulf Coast. He joined the company in January, 1946, as district sales engineer, after having served in the Army. A graduate of Texas A.&M. College, he had previously served with Stanolind Oil and Gas Company as an engineer, and with Baroid Sales division of National Lead Company as a service and sales representative.

HOMCO Promotes C. P. Smith to Southwest Texas Division Manager

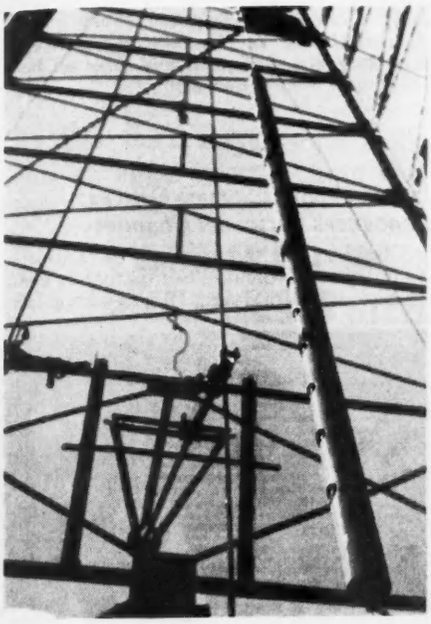
Houston Oil Field Material Company, Inc., announced new divisional sales territories by the promotion of C. P. Smith from district manager to Southwest Texas division manager, with stores at Bay City, Victoria, Kenedy, Corpus Christi, Premont, Alice, Freer, Sullivan, Texas, and office at San Antonio.

C. P. Smith

Serving as district managers under Smith are R. M. Freeman, serving Bay City, Victoria, Kenedy, and headquartering at Victoria; and R. L. Lynd, in charge of Freer, Premont, Sullivan City, and headquartering in Alice.

Smith has been with the company 17½ years. He will headquarter in Corpus Christi.

EQUIPMENT and SERVICE SUPPLIERS' NOTES



60-SHOT GUN PERFORATOR—Unusual view of one of the McCullough 60-shot gun perforators used to break the record for gun perforating.

McCullough Tool Again Exceeds Its Record for Gun Perforating

Working under heavy mud conditions in a whipstocked hole, a crew of McCullough Tool Company service men recently shattered their own world's record for gun perforating for the fifth consecutive time in two years. A total of 6870 holes were shot in 5½-inch casing between 5100 and 3785 feet in an oil well in the Ventura, Calif., area, breaking the previous world's record by 330 holes.

After 1700 holes had been shot, oil began to flow at such a rate that all operations had to be halted until the well was brought under control.

At the same time that the record well was being gun perforated, two other wells were also being shot by McCullough for the same company. Exactly 3900 holes were shot in the first well, 5830 holes were shot in the second well, making a total of 16,600 holes in three days of shooting, also a world's record.

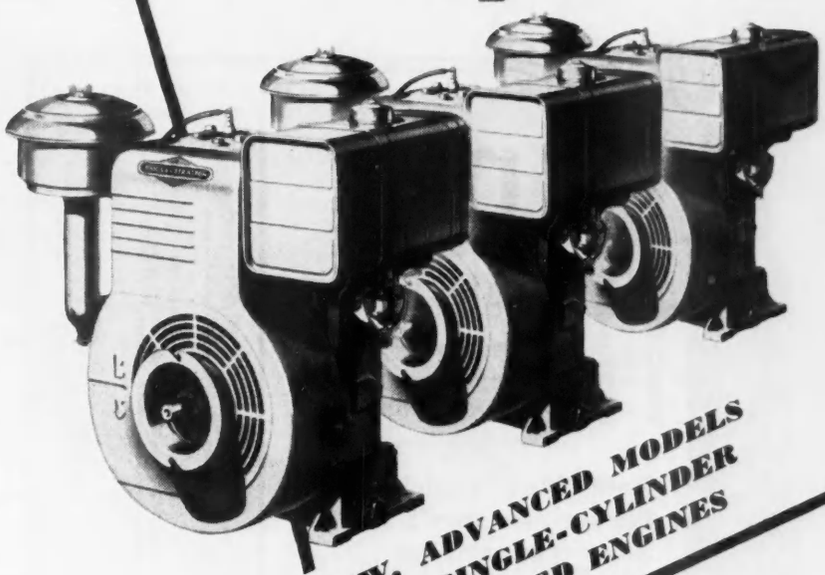
Kerotest Elects Stanley Roush; Appoints Frame Works Manager

Stanley J. Roush has been elected president and general manager of Kerotest Manufacturing Company, Pittsburgh. W. G. Swaney was named vice president and secretary and R. E. Lane, treasurer. Robert C. Downie and John D. Dupuis were elected directors.

W. M. Frame

W. M. Frame has been appointed works manager in charge of all manufacturing operations. He was formerly works manager, Spang Chalfant division of National Supply Company.

From Air-Cooled Power Headquarters



. . . 3 NEW, ADVANCED MODELS OF 4-CYCLE, SINGLE-CYLINDER AIR-COOLED ENGINES

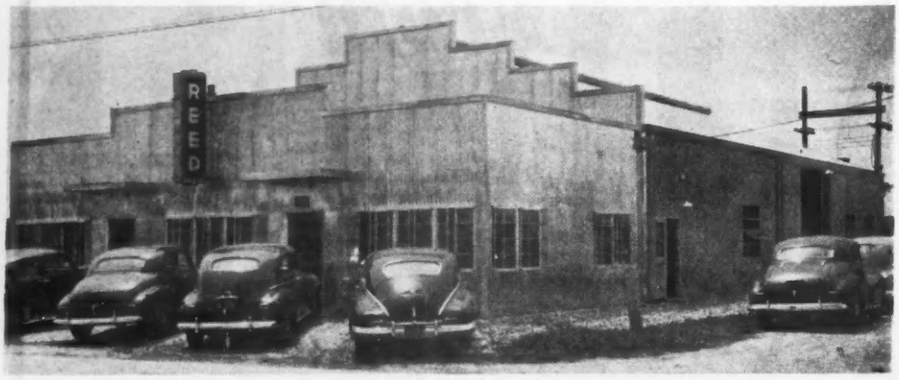
Compact — powerful — in brilliant modern design — incorporating many important improvements — these new Briggs & Stratton models are perfected products of the world's largest builders of 4-cycle air-cooled single-cylinder engines, resulting from an experience record spanning more than 30 years and a production record of more than 4 million engines.

These new engines set new standards of value, dependability and performance as "preferred power" for machines, tools and equipment used in industry, and construction, by railroads and on farms.

Complete technical information is available on these new Briggs & Stratton single-cylinder 4-cycle air-cooled gasoline engines:

MODEL "9" 3.1 H.P.
MODEL "14" 5.1 H.P.
MODEL "23" 8.25 H.P.

BRIGGS & STRATTON CORPORATION, MILWAUKEE 1, WIS., U.S.A.



SERVICE PLANT—Reed Roller Bit Company, Houston, has completed a new service plant at Houma, La., for sales and service of Reed Rock Bits, tool joints and other oil field equipment.

Use Acme Cable Tools

TRUSTWORTHY SINCE 1900

Fig. 265 Heavy Duty Collar Buster

Part Pipe Quicker, Lessen Hazards .. Save More Pipe . . .

Acme's Heavy Duty Collar Buster parts casing QUICKER—than a Ripper—and assures greater SAVING of pipe . . . Quite an item these days, of costly, scarce materials!

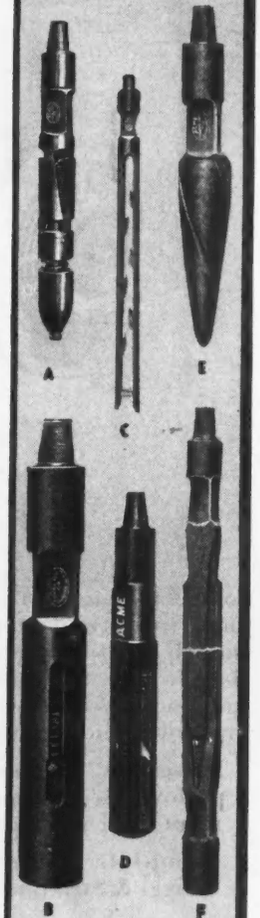
Lower Buster to proper depth . . . raise until knife engages pipe-end, at coupling. Hitch on . . . apply pressure on casing . . . knife is forced to rip ribbon of casing out of collar, by few upward strokes of Jars. Knife turns over . . . you pull tools, then casing.

Pipe parted by Acme's Buster won't collapse on tools . . . Slight damage to collar . . . threads left in good condition for running steel nipple. Save that pipe!

Acme's half-century reputation—for invariable Trustworthy Tools—backs our Collar Buster. Knives of choicest tool steel. Uniform PREMIUM-quality steel . . . throughout . . . controlled by rigid analysis specifications. CORRECT heat-treatment, to electrical-automatic exactness.

See Acme's latest Catalog & Manual in Composite Catalog (Vol. 1). Or mail penny postal TODAY for your copy . . . chock-full of valuable information for every Cable Driller.

More of EVERYTHING You Need in an Acme String . .



See other Acme Fishing Tools in panel (right) . . for more of EVERYTHING you need in a Trustworthy String.

A—Trip Spear—3-Slip
B—Combination Socket
C—2-Prong Latch Grab
D—Perforator
E—Mandrel or Swage
F—Fishing Jar

Acme Fishing Tool Co.
PARKERSBURG, W. VA.
Export Office: 19 Rector St., New York 6, N. Y.

ACME DRILLING & FISHING TOOLS
Since 1900

Lufkin Expands Service Offices; Announces Personnel Changes

The seventh division of Lufkin Foundry and Machine Company has been opened at Effingham, Ill., to serve Illinois, Kentucky, Indiana and Michigan. Lewis W. Breeden, manager of the division, spent a month in the main plant at Lufkin, Texas, and made an extended tour of fields in the Southwest.

Lewis W. Breeden

Val Gallia

Breeden was a consulting engineer, and prior to that was with The Carter Oil Company as a mechanical engineer. He is a graduate of Monmouth College in Illinois.

Val Gallia, who has been service engineer for the past two years for the Gulf Coast division, Houston, has been placed in charge of a new district office in Brookhaven, Miss. He is succeeded in Houston by Billy Burnett, who has been in the shop organization at Lufkin for several years. Burnett attended Texas Christian University and Louisiana Polytechnic Institute.

Ben Sargent

Billy Burnett

Ben Sargent has completed his shop trainee period and has been assigned to the Kilgore district office.

Rector Adds Representative

Blake V. Fisher has joined Rector Well Equipment Company, Inc., as sales representative on the Upper Gulf Coast of Texas, with headquarters in Houston. Fisher, who will specialize in the Rectorhead well head equipment and Rector Fulbore cementing method, is a member of Nomads, and API Division of Production.

THOMPSON-HAYWARD

FORMALDEHYDE

for corrosion control

You can protect your casings, rods, and all exposed metal parts for only a few cents a day. You can

- **SAVE ON PULLING COSTS**
- **SAVE ON NEW STEEL**
- **SAVE ON SHUTDOWN TIME**

Thompson-Hayward Formaldehyde gives dependable protection from hydrogen sulphide corrosion and corrosive mine and well waters.

Write our nearest office for detailed information

THOMPSON-HAYWARD CHEMICAL CO.

Dallas **Houston** **Denver**
Wichita **Tulsa** **San Antonio**
New Orleans

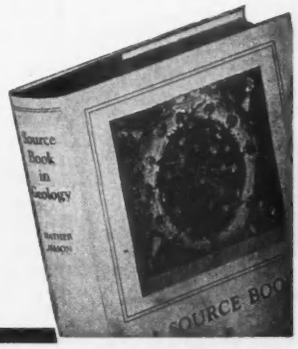
(B)

A Source Book in Geology

By KIRTLEY F. MATHER, Professor of Geology, Harvard University, and SHIRLEY L. MASON, Geologist. 702 pages, illustrated $7.00

This new book gives a comprehensive view of the development of geological science during the last four centuries, by presenting the significant passages from writings of the great contributors to that science in the past.

The excerpts include portions of the work of 130 geologists, original statements of many important principles and theories thus being made available. Many of the excerpts are translated from Latin, French, German or Italian.

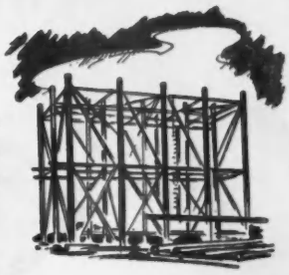


Send Orders to the

GULF PUBLISHING CO.

P. O. BOX 2608 HOUSTON, TEXAS

The Story of AVONDALE and the OIL BUSINESS



Giant STEEL platforms built for offshore drilling. Write for details.

From WAR to OIL... Conversions of all types and sizes of craft.

Personnel and service launches built of STEEL! Speedy, efficient, rugged.

Towboats built and repaired. Marine work is our specialty.

AVONDALE

MARINE WAYS, Inc.

Main Plant: Avondale, La. *Quick Repair Plant: Marrero, La.*

MAIL: WESTWEGO, LA.

This Trouble-Free
PIPE WRENCH
Saves Time and Money

RIDGID's guarantee means no pipe wrench housing expense—ever

● No time out for pipe wrench housing repairs and expense with the guaranteed RIDGID. Sturdy construction and work-saver features make it on-the-job always, make jobs easier, too. Adjusting nut spins freely in all sizes, 6" to 60." Handy pipe scale on hookjaw. Instant action non-slip, non-lock jaws. Powerful comfort-grip I-beam handle with flared end that keeps your hand from slipping off. It's the world's most popular wrench for good reasons. . . . Buy RIDGID wrenches at your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL CO. • ELYRIA, OHIO

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Lester B. Swan

C. L. Power, Jr.

South American, New Orleans Managers Are Named by Dowell

Lester B. Swan, Dowell Incorporated district manager at New Orleans, has been named general manager of United Oilwell Service, S.A., in Caracas, Venezuela. United Oilwell Service is an associate company of Dowell.

Swan served as development engineer for Dowell in Tulsa before being promoted to the New Orleans position in 1948. A graduate petroleum engineer from the University of Tulsa, he formerly was with Stanolind Oil and Gas Company's Production department.

Charles L. Power, Jr., district development engineer in Lafayette, La., has been named district manager in New Orleans. Power, who has been with Dowell since 1936, attended Southwestern college in Memphis.

The New Orleans district includes the New Orleans office, and stations at Lafayette and Houma. John Hendrick and A. Gionta are the respective station managers.

Independent Exploration Party Chief Returns from Middle East

E. I. Grizzell

E. I. Grizzell, party chief for Independent Exploration Company, Houston, recently returned from a several years' tour of duty in the Middle East, including Iraq, Qatar, Syria and the Trucial Coast. Grizzell believes his party was among the first to make seismograph surveys in Syria. He has now been placed in charge of an I. X. party in Montana.

Dufek Is Named Representative For Eastman Company Services

The Dufek Oil Well Service Company of Hutchinson, Kansas, has been named exclusive agent for the Eastman Oil Well Survey Company in Kansas, Oklahoma Panhandle, and the northern section of the Texas Panhandle.

This agreement between the Eastman company and Emil Dufek, president of the Dufek company, applies to instrument rentals and equipment; however, directional drilling and oil well surveying work done by Eastman can also be obtained through any of the Dufek representatives.

3 outstanding WALTER units for oilfield and refinery service!

High capacity Fire Fighting Unit

● This 240 hp. Walter unit provides speedy, effective control of oil and gasoline fires. The Four-Point Positive Drive assures traction to reach any location. Accelerates to 45 mph. in one minute. Carries 1,000 gals. of water, 90 gals. of foam liquid, 800 lbs. of carbon dioxide. Two turret jets, three ground-sweeping jets and three handline jets *discharge a total of 4,800 gals. of fog-foam per minute, which blankets, smothers and seals the fire.*

Combination Tractor and Winch Truck

● Equipped with demountable winch equipment and fifth wheel, may be used interchangeably to lift and carry 10-ton loads; to drag 20-ton loads; or to haul 25-ton capacity pole or semi-trailers. Four-Point Positive Drive provides 100% traction to travel to any off-highway location. Motors from 185 to 290 hp. gasoline, or 260 hp. diesel. Winch equipment and wheelbase may be modified to meet your needs.

For heavy duty, off-the-road hauling

● This giant Walter Tractor Truck combines tremendous power, traction and ruggedness for trailer hauling of huge rigs, pipe and equipment to toughest off-highway locations. The Four Point Positive Drive provides non-slip traction in sand, mud, snow, slippery surfaces. 250 hp. gasoline, 260 hp. diesel or 300 hp. butane engines. Large single tires, 16:00-24, provide maximum rolling ability.

Write for full details on these Walter units.

WALTER MOTOR TRUCK COMPANY
1001-19 Irving Avenue, Ridgewood 27, Queens, L. I., N. Y.

WALTER
4-POINT POSITIVE DRIVE
TRACTOR TRUCKS

WORLD OIL announces its

CANADIAN ISSUE

DECEMBER, 1949

Now World Oil will give you the facts about western Canada, reported direct from the most fabulous new oil area to come over the horizon in many years.

World Oil field editors have been in the area since the thaw, developing exclusive editorial data for this December Canadian issue—touring the fields, visiting on derrick floors, contacting oil company and government officials.

If you're curious about what's going on in western Canada, if you're actively concerned with activities there, then you can't afford to miss this authoritative issue.

World Oil will bring western Canada into clear focus, localizing its activities, its operating problems and economics for the widest possible interest of progressive oil men everywhere.

Make sure that you will have a personal copy of World Oil's Canadian issue, certain to be one of the outstanding editions of an American oil paper in many years. Subscribe to World Oil today. Clip and mail the order blank below TODAY.

WORLD OIL

PUBLISHED MONTHLY

I want to receive WORLD OIL. Here's my check for

☐ 3 years for $4; ☐ 2 years for $3; ☐ 1 year for $2

NAME_____ POSITION_____

COMPANY_____

STREET & NO._____

CITY & STATE_____

Check branch of industry

☐ Drilling Contractor ☐ Producing Company ☐ Pipe Line ☐ Individual Producer ☐ Manufacturing ☐ Supply

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Avery G. Van Campen

Ralph C. McDonald

Clark Bros. Announces Promotions, Additions to Engineering Staff

Clark Bros. Company, Inc., Olean, N. Y., has promoted Avery G. Van Campen, formerly sales engineer in the New York office, to district manager of the Chicago office, 1027-29 Peoples Gas Building.

T. P. Latimer

After attending Yale University, Van Campen was employed in 1936 in the company's Experimental Engineering department. During the war, as job engineer he was responsible for special government research projects. In 1945 he was transferred to the New York sales office as district engineer and was later promoted to sales engineer.

Van Campen is succeeded at New York by R. C. McDonald, who was transferred from an associate company, Pacific Pumps, Inc. After graduation form Northeastern University in 1939, McDonald attended a Worthington student training course and in January, 1940, was assigned to the Centrifugal Pump Application division. In June, 1943, he joined Foster Wheeler Corporation, and in March, 1946, he was employed by Pacific Pumps as a sales engineer in the New York office.

T. P. Latimer has joined Clark Bros. in the Turbo-Machinery Sales division at Olean. Latimer, a graduate in mechanical engineering from Cornell University, served with the 76th Infantry division in Europe during World War II.

J. B. Beaird Company Adds Three Sales Representatives

Robert Ching, formerly with A. O. Smith Corporation, has joined the sales staff of The J. B. Beaird Company, Shreveport, and will represent the company in the New Orleans, Baton Rouge, and Lake Charles area.

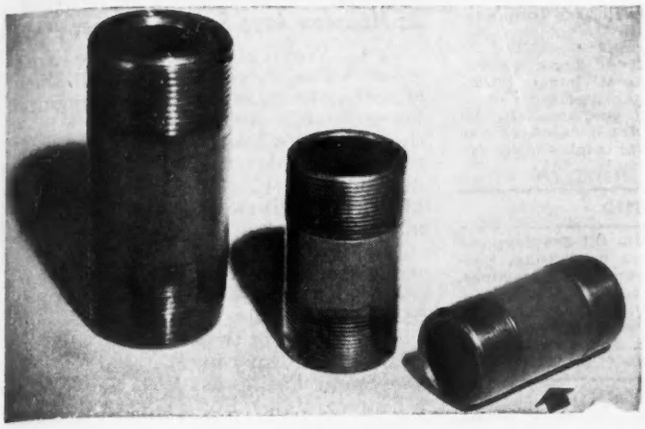
Homber B. Mogle has been assigned as representative in the Kansas and Nebraska areas.

J. Robert Meek of Tulsa has been appointed sales representative for The J. B. Beaird Company of Shreveport. For the past 16 years, Meek has been with the Happy Company of Tulsa as sales and development engineer.

LONGHORN QUALITY

SINGLE X and DOUBLE X LATHE CUT

SEAMLESS NIPPLES



Manufactured from new seamless tubing, precision machined for bevel and taper, threaded and accurately gauged. Threads are positively protected from rust, corrosion and damage by a plastic coating, which is easily peeled off when ready to use.

Sizes ¼" through 6⅝" in standard lengths. Special sizes, brass, stainless and monel furnished to requirements.

SOLD ONLY THROUGH SUPPLY STORES

Write for literature and price lists

Longhorn MACHINE WORKS

6823 Navigation

Houston, Texas

Dallas Branch: 3901 Southwestern

Oil: Titan of the Southwest

By

CARL COKE RISTER

This book, the fruit of three years of steady research and writing, is the story of the discovery and production of oil in the "Great Pool"—from the days of the so-called oil springs, through Spindletop, Glenn Pool, Mexia, Oklahoma, East Texas and other strikes. It is an absorbing account of the men who have produced the prime resource of an industrial civilization, written by a distinguished historian of the Southwest.

A significant and important contribution, which will be of great value and interest to everyone, from the prospector, investor, and tool pusher, to the average American who has hardly been aware of the enormous transformation which has carried the United States into the "age of oil."

CHAPTER HEADINGS:

Texas' Oil—Spring Era
The Red Man's Hidden Wealth
From Paola to Neodesha, Kansas
Corsicana, the Curtain Raiser
Queen of the Neches
Exploiting Other Salt Domes
Red Fork, Cleveland, and Glenn Pool
Louisiana in the News
Exploring the Red River Uplift
Oklahoma Steals the Show
The Ranger Oil Boom
Desdemona and Breckenridge
Along the Mexia Fault Zone
Competition in Oil
An Osage Monte Carlo
Arkansas' El Dorado
Texas Forges Ahead
Greater Seminole
Oklahoma City's Bonanza Field
Panhandle Oil and Gas
Permian Basin Discoveries
Fabulous East Texas
Finding New Horizons
Oil Conservation and Control
Oil at War
An Era of Specialization
The Impacts of Petroleum

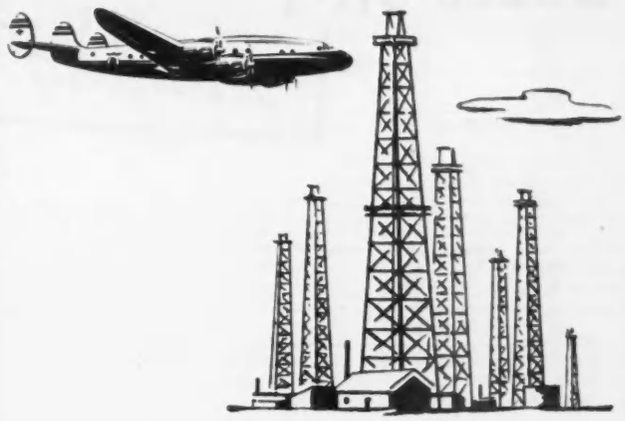
432 pages, 40 pages of illustrations, maps, charts and graphs—Price $5.00.

Send orders to

THE GULF PUBLISHING COMPANY

3301 Buffalo Drive

HOUSTON, TEXAS



Fly KLM to the Oil Centers of the World

FROM MIAMI TO

ARUBA, CURACAO
CARACAS, MARACAIBO
and
BARCELONA (PUERTO LA CRUZ)

FROM NEW YORK TO

CAIRO, THE MIDDLE AND FAR EAST

KLM's 75,000-mile Royal Route is particularly popular with executives and engineers whose business takes them to the oil centers of the world. Daily *Constellation* flights from New York and Miami.

K·L·M ROYAL DUTCH AIRLINES

1919 30TH YEAR 1949

THE WORLD'S *FIRST* AIRLINE
TO ACHIEVE ITS 30TH ANNIVERSARY

FOR INFORMATION SEE YOUR TRAVEL AGENT or KLM Royal Dutch Airlines, 572 Fifth Ave., New York, N Y. LU 2-4000; 308 N.E. 1st Street, Miami 3-8455. Other KLM offices in Los Angeles, San Francisco, Chicago, Washington, Boston and Montreal.

WORLD OIL'S Trading Post

CLASSIFIED ADS

SERVICES · PERSONNEL · USED EQUIPMENT

RATES: Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

FOR SALE

■ **ROTARY equipment almost new, only used few days, 1800' PK rods, Drill collar 30'x4¼" with 3½" box, King water swivel 1¼", PK slips, hoist plugs, overshot. Complete outfit $4500 or will divide. We handle new and used spudders, rotaries, core drills, pipe, tools, cable. Fishing tools and equipment rented. Pressey & Son, Pueblo, Colo.**

■ FOR SALE: 1945 Sullivan #200 Mounted on White Truck. Contact James H. Green & Co., Day Phone 9884, P.O. Box 1465, San Angelo, Texas.

■ FOR SALE. Failing Model 1500 Heavy Duty Rotary drilling rig equipped with 4½" x 6" mud pump mounted on 1948 International KB6 truck, complete with drill pipe, subs, tools, etc. Also 800 gallon custom built water tank, equipped with vacuum lift, mounted on 1948 International KB6 truck. All equipment in excellent condition. Address: Box 48W, c/o World Oil, Houston, Texas.

■ Five three phase electric motors. Twelve locomotive type air jammers. Mullins Machine Company, 125 Houston Harbor, Houston, Texas. WE ntworth 1978.

For Sale

120 Type C Foxboro Orifice Meters with piping Mercury and 4 inch Saddles.

10 Type 204 Foxboro Orifice Meters

25 100" 250# Westcott Orifice Meters

3 100" 500# Emco Orifice Meters with Piping

5 No. 3 500# Emco Positive Meters

Pressure Gauges, Fisher and Chaplin-Fulton Regulators. All Equipment in Good Condition.

MILNER OIL AND GAS CO.
Box 457
Okmulgee, Oklahoma

MACHINE TOOLS FOR SALE

5 Bullard Vertical Turret Lathes, 42" tables; 5 Bullard two-head Maxi-mills, 42" tables. All in first class usable condition, complete with motors. Also other machine tools.

The Locomotive Finished Material Co.
Atchison, Kansas

HELP WANTED

MECHANICAL ENGINEER

Thorough university background followed by five or more years of outstanding achievement a definite requirement. Must have creative ability, a precision-technical mind. Men of less ability should not make inquiry. Salary commensurate with rigid requirements. A Missouri corporation. Correspondence confidential. Address: Box 45W, c/o World Oil, Houston Texas.

CORROSION MAN

Must have broad thorough technical education, not less than five years of successful experience. Requirements stiff. Salary in keeping with ability. Address: Box 46W, c/o World Oil, Houston, Texas.

HELP WANTED

■ **NEW foreign and domestic Oil Employment Directory. Over 500 listings in drilling, production, refining, natural gasoline, pipelines, geological, exploration, supplies, manufacturers, services; and trucking, refinery and pipeline contractors, showing where to apply for jobs. Price $5.00. Oil Industry Mailing List, Box 2603, Tulsa, Okla. (Our 29th Year).**

SITUATIONS WANTED

■ Chemical Engineer. Recent graduate, B.S. Tau Beta Pi and Sigma Tau. 23 years old, married, veteran, hard worker. Consider anything. Address: Box 42W, c/o World Oil, Houston, Texas.

■ Two young ex-service pilots. Clean cut appearance. Three years college. Unmarried. Free to travel. Domestic or foreign. Extensive sales and business experience. Current valid CCA instrument ratings and commercial pilot certificates (single and multi-engine, land and sea). Familiar all types of aircraft. Desire positions as personal pilots and business aids. Excellent references. Address: Box 44W, c/o World Oil, Houston, Texas.

Maintenance Engineer Available

Graduate mechanical engineer, 39, with 18 years experience, as maintenance engineer on plant equipment and supervisor of plant construction. Veteran Naval Officer now living in Huntington, West Virginia desires change. Address: Box 47W, c/o World Oil, Houston, Texas.

LEASES, DRILLING, ACREAGE, ETC.

■ **Recent strikes have focused attention on Montana's deeper oil zones and major companies are moving in fast, drilling and leasing. We buy direct in the field, sell direct to our customers. Write LANDOWNERS ROYALTIES COMPANY, Box 1225, Great Falls, Montana.**

NOTICES

■ BUSINESS CARDS EMBOSSED, Blue or Black Raised Letters, 1,000 for $4.85, Postpaid, Guaranteed Satisfaction, America's Finest Value. Mail copy and check to LYON PRINTERS, 420 Waite Ct., Long Beach 12, California.

ATTENTION

Well established oil well drilling contractor desires to manage and supervise: Individual's, group's, small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired.

Makin Drilling Company
Box No. 131 Phone No. 131
Hobbs, New Mexico

Independent Geologist who wants to locate in Rocky Mountain area, we will furnish office (furnished) phones, stenographer, etc., in Denver office free, for a conservative amount of consultation. Address: Box 43W, c/o World Oil, Houston, Texas.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Walling Joins Nordstrom Division As Houston Area Sales Engineer

B. C. Walling has joined the Nordstrom Valve division of Rockwell Manufacturing Company as a sales engineer. He will work out of the company's Houston office under the direction of C. K. Madison, district manager.

B. C. Walling

Walling was graduated from Southern Methodist University as a mechanical engineer. He spent two years in the Navy in the South Pacific as a lieutenant (jg). For the past three years he has been employed by Humble Oil & Refining Company as a petroleum engineer.

He will be located in Corpus Christi and will handle the work in the oil fields formerly handled by R. J. Munn, who was transferred to another territory.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, and JULY 2, 1946

Of WORLD OIL, published monthly at Houston, Texas, for October 1, 1949.

State of Texas, County of Harris, ss:

Before me, a Notary Public in and for the State and County aforesaid, personally appeared A. L. Burns, who, having been duly sworn according to law, deposes and says that he is the Business Manager of WORLD OIL and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily, weekly, semiweekly or triweekly newspaper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946, (section 537, Postal Laws and Regulations), printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Ray L. Dudley, 3371 Chevy Chase, Houston, Texas; Editor, Warren L. Baker, 1613 Woodhead, Houston, Texas; Managing Editor, Albert B. Reese, Jr., 402 Gulf, Houston, Texas; Business Manager, A. L. Burns, No. 7 Chelsea Place, Houston, Texas.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

The Gulf Publishing Company, Houston, Texas; James Anderson, Houston, Texas; A. L. Burns, Houston, Texas; J. F. Carter, Jr., Tulsa, Okla.; Mrs. Mary Margaret Cashman, Houston, Texas; Mrs. Carolyn Dodson Dudley, San Angelo, Texas; June Wooden Dudley, Trustee for Miss Fredrica Lucinda Dudley, Houston, Texas; Ray L. Dudley, Independent Executor and Trustee of Estate of Dr. N. L. Dudley, Deceased, Houston, Texas; Ray L. Dudley, Houston, Texas; Wm. G. Dudley, Houston, Texas, Mrs. Libbie Rice Farish, Houston, Texas; Wm. V. Gross, Utopia, Texas; Mrs. Anita S. Lane, Houston, Texas; Chas. H. Lane, Houston, Texas; Tom W. Nelson, Houston, Texas; Mrs. Maude G. Sterling, Houston, Texas; O. R. Waller, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) M. D. Anderson Foundation, Houston, Texas.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. L. BURNS, Business Manager.

Sworn to and subscribed before me this 16th day of September, 1949.

P. J. AUCOIN,
(Seal) Notary Public in and for Harris County, Texas
(My commission expires June 1, 1951.)

New Books, Maps and Movies

Story of Petroleum

Petroleum, its rich history and its growth from scratch to leadership in the industrial world in less than 90 years, is the subject of the new edition of "Petroleum, The Story of An American Industry."

Information on the origin, source, and uses of petroleum and its products, as well as factual data on the complex operations of the industry itself, are contained in the book. Special chapters are devoted to discovery and production, refining, transportation, marketing and conservation.

J. A. McNally, American Petroleum Institute, 50 West 50th Street, New York 20, $1.

Oil Conservation

A pamphlet entitled "Saving Your Oil" contains statements by the governors of 14 states on what the individual states are accomplishing in oil and gas conservation, along with other material on this subject.

Interstate Oil Compact Commission, P. O. Box 3127, State Capitol, Oklahoma City 5, Okla.

Engineering Data Book

An engineering data book for users of pumps, turbines, compressors and gears has been compiled. The book, "De Laval Engineering Handbook," was edited by Austin H. Church and Hans Gartmann.

Advertising Department, De Laval Steam Turbine Company, Trenton 2, N. J., $2.

Geological Digest

The Tulsa Geological Society has published its 17th annual Digest, edited by John C. Maher of the U. S. Geological Survey.

The 196-page volume contains 32 illustrations and 23 digests of papers on foreign and U. S. regional and local geology, geophysics, photogeology, and exploration policies. Papers on the Velma, Ceres, Sholem Alechem, and NW Sulfur pools of Oklahoma, the Lawson-Chapman area of Texas, and the Anadarko Basin of Oklahoma and Kansas are included. A directory of members listed both by name and company affiliation is appended to the text.

V. L. Frost, The Ohio Oil Company, Thompson Building, Tulsa, $1.

Motion Picture Catalog

Film Counselors, New York consulting firm, has prepared a manual and catalog on motion pictures and slide films suitable for employe training in petroleum and allied fields. The catalog contains a source index and geographical list of film libraries, as well as suggestions for the efficient use of films in training programs. It also includes an analysis of available films.

The catalog is the result of a recent survey conducted under the direction of William T. Gunn of the American Petroleum Institute.

American Petroleum Institute, 50 West 50th Street, New York 20, $3.

Gas Measurement Report

The revised 1948 edition of "Gas Measurement Committee Report No. 2," prepared by the Gas Measurement Subcommittee of the Technical Research Committee of the American Gas Association's Natural Gas Department, contains recommendations covering the use of orifice meters in the measurement of natural gas.

An errata sheet with corrections included in the new edition will be sent free of charge to persons who wish to bring the 1945 edition up-to-date.

American Gas Association, 420 Lexington Avenue, New York 17, $1.50.

Here's the Mighty Hook-up for Improved Drilling
THE 36-200 REGAN
Narrow-Type Traveling Block and Forged Steel Combination Casing Hook
200-TON CAPACITY
...but only 135½" from bight of hook to top of traveling block—the shortest overall working height ever offered for such capacity!
ADVANCED DESIGN
Special adapter reduces friction, allowing the forged alloy steel combination hook to smoothly swivel at the right angle to traveling block sheaves. The traveling block is compact, narrow, streamlined for maximum safety and ease of operation.
FITS PORTABLE RIGS
Being four feet shorter, narrow and compact, this new Regan Combination is perfectly suited to portable drilling operations.
Write today for your copy of our new fully informative bulletin!
Regan
Quality
Forge & Engineering Co.
SAN PEDRO, CALIF.
HOUSTON, TEXAS
Exclusive Mid-Continent Representatives:
Hunt Tool Co.,
P.O. Box 1436, Houston, Texas
Exclusive Export Representatives:
Hunt Export Co., 19 Rector St., New York, N. Y.
Avda Pte., R. Saenz, Pena 832, Buenos Aires, Argentina

PARMACO
PARKERSBURG MACHINE CO.
PARKERSBURG, W. VA. U.S.A.
The House of Courteous Service

EXCLUSIVE EXPORT DISTRIBUTOR
PETROLEUM MACHINERY CORP.
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

PARMACO
MEANS
QUALITY
•
ASK YOUR
FAVORITE SUPPLY
HOUSE FOR
PARMACO
PRODUCTS
•

PARKERSBURG
MACHINE
COMPANY
PARKERSBURG, W. VA.

HEAVY DUTY-
RUGGED....

THE
INDUSTRY'S
LEADING
CENTRIFUGE

*3480

You can maintain your required speed for the full period of the test with much less effort. Curtin centrifuges, proven world-wide, are heavy duty, rigidly constructed, and extremely simple in design. Illustrated bulletin, giving full details, available upon request.

W·H·CURTIN & CO.
HOUSTON .... NEW ORLEANS

SQUEAKS from the BULLWHEEL

Good Risk

A business man and his partner closed their office at noon one Saturday and went to the movies. When they were seated, one of them nudged the other and gasped, "Gosh, Joe, we forgot to close the safe!"

"What's the difference?" answered the other. "We're both here, aren't we?"

Of Moose and Men

A Scotsman, on a visit to Canada, noticed the mounted head of a bull moose hanging in the hall of the house where he was staying. He asked his host what kind of an animal it was.

"Oh, that's a moose," said his host.

"A moose!" exclaimed the Scot. "Eh, mon, what like are your rats over here?"

Well-Rounded

She: "Don't you think dancing makes a girl's feet larger?"

He: "Yes."

She: "I rather think that swimming gives a girl awfully big shoulders, don't you?"

He: "Yeah."

Pause.

He: "You must ride quite a bit, too."

Old Hand

Two small boys at the Salvation Army dinner put their grimy little hands side by side on the white table cloth.

"Mine's dirtier than your'n!" exclaimed one, triumphantly.

"Huh!" snorted the other disdainfully, "You're two years older'n me."

Beau Peep

Girls, when they went out to swim,
Once dressed like Mother Hubbard.
Now they have a bolder whim:
They look more like her cupboard.

'Tain't Possible

An election board in the deep south was counting ballots. A Republican ticket showed up and they examined it and put it aside as suspicious only. After several hours, another Republican ballot showed up and the judge announced: "That son-of-a-gun voted twice. Throw 'em both out."

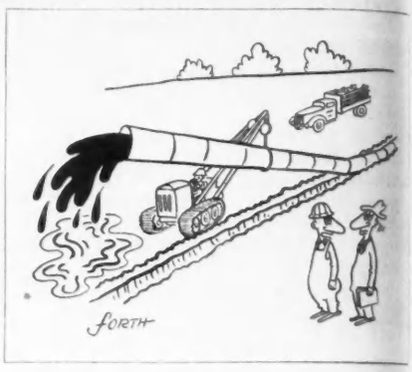
Grammatical Viewpoint

While crossing the college campus, a freshman met one of his instructors and said, "What's your guess about the game coming up with California next Saturday. You don't think we'll do too bad, do you,"

"Don't you mean 'badly'?" inquired the professor.

"What's the difference?" said the frosh. "You know what I mean."

"An 'l-y' can make quite a difference," said the professor. He pointed to a passing co-ed. "For instance, it makes a difference whether or not you look at her sternly, or at her stern."



"You'd think they'd wait till we finished the line!"

PETROLEUM ENGINEERS
CABLE & STINE
WICHITA FALLS, TEXAS

EXPERIENCED PRACTICAL
AND TECHNICAL CONSULTING
PRODUCTION ENGINEERING
SERVICE
•
SPECIALIZING
in
MODERN
SECONDARY
RECOVERY

10 GOOD REASONS WHY OPERATORS PREFER

McCullough
GUN PERFORATOR SERVICE

1. **MEETS EVERY CONDITION.** Guns fired either electrically or mechanically: guns run on cable, sand line, drill pipe, tubing, or on piano-wire measuring line in extremely high-pressure wells.
2. **SIMULTANEOUS FIRING** under all conditions gives exact spacing of shots, perfect perforation pattern, and saves down-the-hole time.
3. **ACCURATE DEPTH MEASUREMENTS** put the shots right where you order them.
4. **MAXIMUM PENETRATION** of bullets into the formation, as proved repeatedly in competitive field tests.
5. **GUNS TO FIT EVERY CONDITION.** McCullough employs more than 30 different types and sizes of guns.
6. **ALL SIZES OF BULLETS** from ½" dia. up to ¾" dia., to fit every possible need.
7. **BURRLESS BULLETS,** giving a completely burr-free hole, eliminating casing scraping, with *no* sacrifice of penetration.
8. **NO LOST TIME.** McCullough's simpler, lighter equipment cuts setting-up and moving-out time, speeds up every job.
9. **EXPERIENCED MEN.** With years of experience behind them, thoroughly-trained McCullough gun-perforating crews do their jobs quickly, efficiently, safely.

These Are Some of the Reasons Behind the Proven Fact That

McCullough

PUTS THE SHOTS WHERE THEY COUNT!

10 This is a section of a McCullough **90-SHOT GUN** perforating a 15-foot section with 6 holes to the foot, at one run.

McCullough TOOL COMPANY

5820 South Alameda St., Los Angeles 11, California
405 McCarty Avenue, (P. O. Box 2575) Houston, Texas

31 SERVICE LOCATIONS

TEXAS: Alice, Houston, Cisco, Corpus Christi, McAllen, Odessa, San Angelo, Tyler, Victoria, Wichita Falls. **OKLAHOMA:** Oklahoma City, Guymon, Healdton. **MISSISSIPPI:** Laurel. **NEW MEXICO:** Hobbs. **KANSAS:** Great Bend. **CALIFORNIA:** Los Angeles, Avenal, Bakersfield, Ventura. **MONTANA:** Cut Bank. **LOUISIANA:** Houma, Lake Charles, New Iberia, Shreveport. **WYOMING:** Casper, Cody. **CANADA:** Edmonton. **VENEZUELA:** United Oilwell Service. **S. A.:** Caracas, Anaco, Maracaibo.

EXPORT OFFICE: 30 Rockefeller Plaza, New York 20, N. Y.

Flashes from the BEACON

COME NIPPY OCTOBER days, and even the most nose-to-the-grindstone oilman is going to sneak a day now and then and start out with dog and gun on the quest for birds. And although no hunter, the BEACON'S Alberta Wilson Constant knows the hunter's weakness for pheasant. She knows too that pheasant and other game birds deserve nothing less than wild rice when they come to dinner on your table.

* * *

BUT WITH WILD RICE just about as hard to stalk (and as expensive) as the pheasant, Alberta shares with BEACON readers a trick to make tame rice wild. Here it it, as it appeared in the BEACON:

ALMOST WILD RICE

1 cup regular white rice
1 heaping tablespoon butter
1 medium onion, chopped fine

Brown the rice and the onion in the butter until brown (this means the raw rice). Add 1 heaping tablespoon parsley, either fresh or powdered, and 4 cups boiling water and 1 teaspoon salt. Cook on a slow fire until almost all the water is cooked out and then put into a casserole and cook in oven 30 minutes at 350 degrees. The last 10 minutes, remove the lid.

* * *

WHO WE ARE and what we do in Kansas will be in the subject of several features beginning with the OCTOBER issue of the BEACON. Among BS&B personalities spotlighted will be the fabulous (and we don't use the word loosely) Leiker family—dad and umpteen sons who have been servicing BS&B equipment around Hays since "the year one." . . . Makes good reading.

* * *

WANT THE BEACON every month? No charge of course . . . just a request on your company letterhead to:

BLACK, SIVALLS & BRYSON, INC.
Industrial and Public Relations Division
720 Delaware
Kansas City, Missouri

SQUEAKS from the BULLWHEEL

Recompense

"What do you get for mowing the lawns?"

"The lady of the house lets me live with her," replied the home owner.

Illustrated Lecture

The man was disconsolate. Everything he did was wrong. So he decided to end it all by hanging himself from a tree. Before he jumped, he decided to explain to the Lord the reason for his action, and raising his head poured out the anguish of his soul—how he was blamed when things went wrong, how others got credit for his acts of merit, how his wife misunderstood him, etc. Just then, a bird flew over and beautifully decorated one eye of his upturned face.

"You see, Lord," said the poor soul. "That's what I mean. For other people they sing."

Money's Worth

The young man hurried up to the counter, laid down five pennies and demanded a can opener. The clerk handed him a nickel and he rushed away happy.

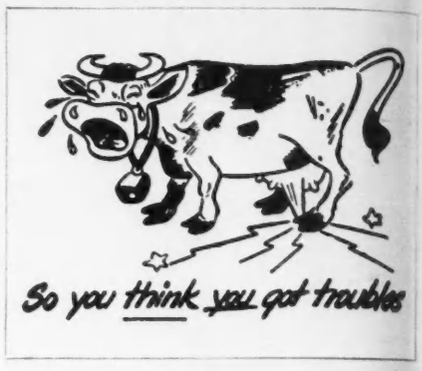
Point of Similarity

A beautiful harvest moon shone down on the parked car in which sat Trudie and her bashful beau.

"Dear, you remind me of Don Juan, the great lover," murmured Trudie.

"Why?" he asked hopefully.

"For one thing," snapped Trudie, "he's been dead for years and years."



Diagnosis

Rastus: "Whut all did de doctor say's de matter wid you?"

Liza: "He says I's sufferin' from acute indiscretion."

Stomach Trouble

Army doctor: "Have you any physical defects?"

Draftee: "Yes, sir. No guts."

Suspicion

"What foah dat doctah comin' out to youah house?"

"Ah don' know, but Ah thinks ah has a little inkling."

Optical Illusion

She was only the optician's daughter —two glasses and she made a spectacle of herself.